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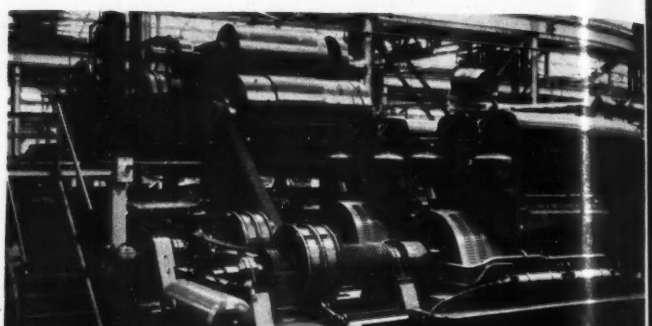
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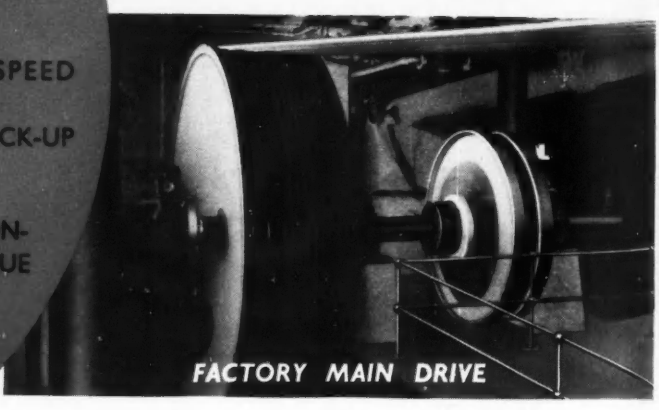
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Parliamentary and Scientific Committee's Discussion on Productivity

EARLY in November, the Parliamentary and Scientific Committee—which consists of members of both Houses of Parliament and representatives of certain scientific and technical institutions—arranged a general discussion on the subject of productivity. During the past week, it has issued a report summarising that discussion. The discussion was initiated by Sir Geoffrey Heyworth, chairman of Lever Brothers and Unilever, Ltd.; Mr. Lincoln Evans, general secretary of the Iron and Steel Trades Confederation; Sir Thomas Hutton, general manager of the Anglo-American Council on Productivity, and Sir Charles Colston, chairman and managing director of Hoover, Ltd. It was summed up at the end of the meeting by Sir George Schuster, an honorary member of the Parliamentary and Scientific Committee, who said that, in considering increased productivity, it was evident that there was still room and need for a great deal of scientific investigation. The whole question of time and motion study had not yet been put on a proper scientific basis, and if the confidence of the workers was to be gained the trade unions must be satisfied that time and motion study methods were valid. Sir George thought that there was need to study all kinds of things which were affecting people's attitude to work. That kind of research work, he said, would never be properly directed or fruitful unless it was carried on with the active interest and co-operation of the people who were concerned with the practical conduct of industry. That meant both management and trade unions.

Merchant Navy Defence

WITH the collaboration of the Ministry of Transport and the representative bodies of shipowners, officers and men, the Admiralty has prepared a scheme for a resumption of the defence courses for Merchant Navy masters, officers and men. Many of the present members of the Merchant Navy were not at sea during the last war and the aim of the courses is to familiarise these officers and men with their particular duties in any future war. At the same time, officers and men with war experience will be able to bring their knowledge up to date. Initially, the courses will be held in London, Liverpool, Glasgow and Newcastle-upon-Tyne, and additional training centres may be opened subsequently at other ports. The training is designed to make known the principles of the system of trade defence of the Royal Navy, and the merchant ships' part in this system so as to reduce the probability of attack to a minimum. It includes the knowledge required for sailing in convoy and details and use of merchant ship defensive equipment so that an attack by an enemy can be beaten off and the mine menace reduced. The courses will take ten days to complete, and that for the officers can be taken in two parts at different centres if necessary, but it is thought preferable for the men to complete the course in consecutive weeks. General information about the scheme will be distributed shortly, and, upon completion of the arrangements at the ports, a monthly programme of instruction will be issued.

Preston Railway Collision Report

THE Ministry of Transport has now published the report of its Inspecting Officer of Railways, Brigadier C. A. Langley, on the collision which occurred on May 13th last between a Preston–Southport passenger train and a stationary light engine at Whitehouse West Junction, near Preston, on the London Midland Region of British Railways. The train, in which there were eighty passengers, was travelling under clear signals at about 20 miles an hour. Eight of the passengers were seriously injured as a result of the collision. The locomotive of the train was derailed and badly damaged, but the light engine kept to the rails and suffered remarkably little damage from the impact. As a result of his inquiry into the accident, the Inspecting Officer concludes in his report that the collision was primarily due to the gross negligence of a signalman who accepted the passenger train without making any proper attempt to satisfy himself that the line was clear. He also acted incorrectly by failing to stop the light engine at the home signal at Whitehouse West and calling the driver forward in accordance with the rules. But, the report says, the driver of the light engine must also bear some responsibility for failing to carry out the rule for sending his fireman to the box immediately after he had been detained at the cross-over. Although the provision of a starting signal, track circuits and modern block controls on the up line would undoubtedly have prevented this accident, the Inspecting Officer says that he is not prepared to recommend that this work be given priority when there are so many other places where these most desirable safety measures are more urgently needed. Whatever safety appliances may be installed, reliance must always be placed primarily on the integrity of the signalman.

Retirement of Sir Eustace Missenden

IT was announced on Saturday last that Sir Eustace Missenden had intimated to the British Transport Commission his wish to retire from the chairmanship of the Railway Executive, a position which he has held since the formation of the Executive three years ago. The Minister of Transport and the British Transport Commission have accepted, with regret, Sir Eustace's resignation and have expressed their appreciation of the outstanding services which he has rendered. Sir Eustace, who is sixty-four, has spent over fifty years in railway service. He joined the South-Eastern and Chatham Railway in 1899, and became London district traffic superintendent in 1920. On the amalgamation of the railways three years later, Sir Eustace was appointed London (East) divisional operating superintendent, Southern Railway, becoming traffic manager in 1936. On the outbreak of the second World War, he was appointed general manager of the Southern, and at nationalisation he accepted the chairmanship of the Railway Executive at the request of the Minister of Transport and the British Transport Commission. In correspondence which the Ministry of Transport has issued, Sir Eustace has referred to what has been accomplished by the Railway Executive in the creation of a central organisation of strength and technical ability, and has recalled the intention—with which he is in complete accord—to review the organisation "after about three years." Taking into account the strain of the past three years, following eight years as general manager of the Southern, Sir Eustace feels that the task of chairmanship of the Railway Executive is one that could now best be carried out by a fresh mind.

Merseyside Ship Repair Facilities

A REPORT, recently published by H.M. Stationery Office, gives the findings reached by the working party set up last February to consider whether additional ship-repairing facilities were required on Merseyside, and, if so, whether they could be provided without interfering with the working of the port. The main conclusions are that no additional berths or dry docks are needed, but improved services, including electric power, compressed air, fresh and salt water, warping capstans and communications would expedite repairs at the public dry docks. It is also advocated that the best use of the dry docks would be achieved by acquiring additional travelling cranes, and that the allocation of floating cranes should be linked with ship-repairing needs. In arriving at its conclusions the working party considered the wartime developments when peacetime facilities had to cope with additional conversion work and naval repairs followed by the large volume of work in restoring the merchant fleet to normal and in completing deferred repairs. In the report, repair work is designated "immobilised tonnage," and "not immobilised tonnage," and a table gives figures for tonnage under these categories for both the United Kingdom and the North-West area. The opinion is expressed that there is no reason to assume that the volume of work will increase in the foreseeable future. Taking into consideration the work in hand from 1946 onwards it is stated that the present figures indicate a capacity for additional repair work. Owing to war damage, only 73 per cent of the Mersey berths are in use, while the tonnage is 103 per cent of the 1938 level. The Mersey Docks and Harbour Board stated that reconstruction was being pressed forward and assured the working party that lay-to berths would continue to be available for ship-repairing. After the war cranes on loan were returned to their owners and some Admiralty cranes were acquired by the Board, but those were not altogether suitable for peacetime services, and the working party agreed that the installation of travelling cranes of greater lifting capacity would increase efficiency without affecting commercial facilities. The commercial demands for the available floating cranes is considerable, but the working party considers that ship-repairing needs should receive more favourable consideration.

The Sheet and Strip Metal Users' Technical Association

THE Sheet and Strip Metal Users' Technical Association has now issued a detailed report of a continental tour undertaken in the early part of September by twenty-seven of its members. It was the first tour of its kind to be organised by the Association, and the report shows clearly that a great deal of valuable technical experience was gained from works visited in Holland, Belgium, France and Germany. In addition, the report sets out some of the more general impressions gathered by those who took part in the tour. They concluded, for instance, that, for the most part, working conditions in the establishments visited were good, although "a number of practices were current which could not under any conditions be countenanced in this country." Another impression gained was that even though they are efficiently laid out, continental factories are not so clean or tidy as the larger factories in this country. The workers, the report says, have to work harder, for longer hours and for less money than in this country, and there is not the same feeling of security. On the other hand, the report emphasises the great attention paid to the lay-out and operation of foundries on the Continent, particular mention being made of the tendency to install fully mechanised foundries wherever possible. One event in the programme, which is recorded in the report, was a joint meeting in Eindhoven of the English Association and the Academical Society, to which the members of the touring party were invited. Four of them addressed the meeting on the organisation and activities of various British technical institutions of which they are members. The arrangements for the tour were made by Mr. Alastair McLeod, honorary secretary of the Sheet and Strip Metal Users' Technical Association.

The Development of the River Rhone

No. IV—THE WORKS AT DONZERE-MONDRAGON—PART II

(*Continued from page 619, December 22nd*)

THE ANDRE BLONDEL POWER STATION

THE general arrangement at the power station is shown in Fig. 25. Extensive reliance was again placed upon model tests in the design of the various parts, to avoid losses of head and hydraulic disturbances which would hinder navigation. The power station itself is situated on the right bank of the canal, with the spillway section next to it, and the lock on the left bank. The canal divides into two channels 1000m upstream of the power station, one branch being for navigation and the second forming the power station forebay. Ample space has been allowed for vessels waiting to use the lock. Downstream, the navigation channel and tail-race rejoin, as indicated in the diagram. Just upstream of the lock there is an intake with a capacity of 25 cubic metres per second, which takes sufficient water for the irrigation of the plain of Orange downstream of Mondragon.

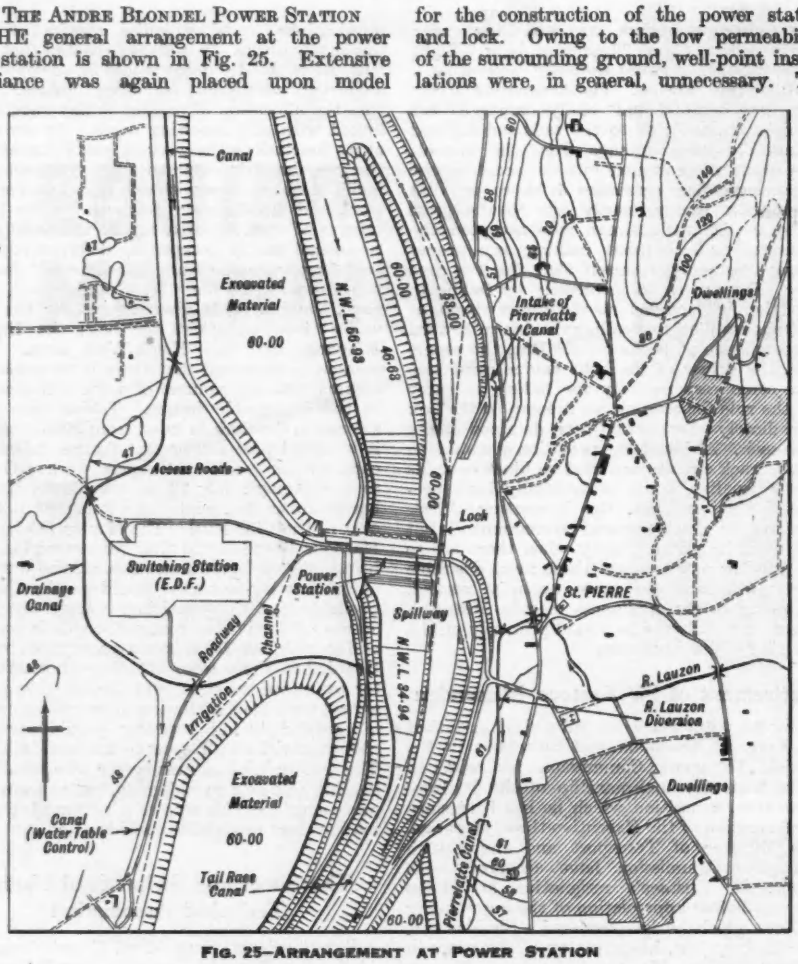


FIG. 25—ARRANGEMENT AT POWER STATION

The power station will be equipped with six Kaplan turbines, each driving an alternator of 50MW capacity, and will be capable of producing an average of 2000 million kWh per year. The maximum head will be 26m and the minimum 16m, and the flow absorbed 1530 cubic metres per second. At present four turbo-alternator sets (groups 2–5) are under construction and the remaining two will be ordered and installed at a later stage. A cross-section through one of the sets is shown in Fig. 26.

The large dimensions of the turbines necessitated excavating to a formation level of 12 N.G.F., about 40m below ground level. More than 3 million cubic metres of excavation, all carried out in the dry, was necessary for the construction of the power station and lock. Owing to the low permeability of the surrounding ground, well-point installations were, in general, unnecessary. The power station itself consists of an auxiliary building 75m long and seven bays, one reserved for servicing, with a total length of about 185m, a width of about 70m and a height of 58m. It is of reinforced concrete construction and, architecturally, is most imposing. It contains two 250-tonne travelling cranes of 18m span, which can be coupled together when required for dismantling and erecting the machines.

The distance across the reinforced concrete scroll casing of each turbine is 20m and the diameter of the runner, which has six adjustable blades, is 6·1m. The runner weighs 120 tonnes and turns at 107 r.p.m. (runaway speed 280 r.p.m.), driving an "umbrella" type 10·5kV alternator. The intake to each turbine consists of three openings, each 5·2m wide and 17m high. Earlier in this article, in the description of the Seyssel project, mention was made of the provision for stopping these turbines, in case of mechanical breakdown. Should the guide vanes become wedged in the open position due to mechanical breakdown, with the alternator out of circuit, the closing of the blades of the runner would produce a speed of about 1·2 times the normal speed.

To avoid sustaining this increased velocity a set of sluice gates is provided to cut off simultaneously all three sluices. There is, however, only one set of gates for the six turbines. These gates can be handled by a large gantry crane, which carries them to the group, where they are required, and places them in position. They are roller gates, composed of elements capable of being articulated, as indicated diagrammatically in Fig. 26. In addition, sets of stoplogs, handled by gantry cranes, are provided upstream and downstream to enclose a turbine for maintenance.

The main transformers and the switching station have been positioned about 500m away from the power station, owing to the presence of spoil heaps and constructional impediments nearer at hand. They will be connected to the alternators by 10·5kV cables, passing through a cable tunnel. Two transformers, each of 50MVA capacity and each corresponding to one turbo-alternator set will raise the voltage to 60kV to feed the neighbouring region and later the proposed S.N.C.F. electrification scheme on the Lyon-Marseilles line. Four further

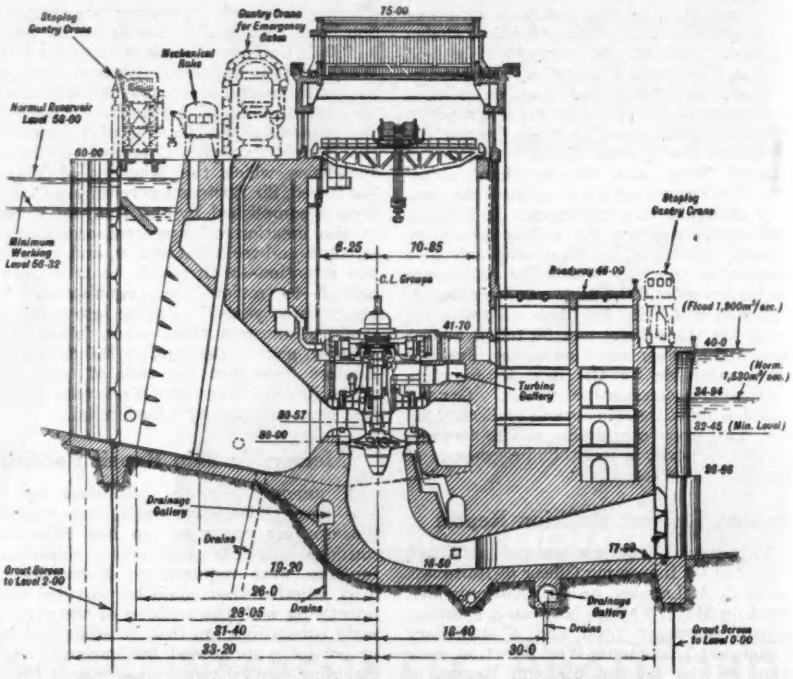


FIG. 26—CROSS SECTION OF POWER STATION

transformers, one for each of the remaining sets, are to be supplied to transform the voltage to 220kV. In addition, there will be a supplementary transformer of 100MVA capacity, capable of being connected to any of the main machines, which will transform from 10·5kV to either 150kV or 220kV to connect to the various E.O.F. grids in the vicinity.

A general idea of the size of the power station, spillway and lock ensemble can be gained from the accompanying illustrations, Figs. 27–29, which show the work in progress and the plant employed. The site is spanned by three cableways of 10·5 tonnes capacity and there is a concrete weigh batching and mixing station on the right bank with a capacity of 300 cubic metres per hour. Considerable use has been made of concrete pumps for transporting and placing the concrete.

Spillway

Owing to the use of a combined navigation and power canal, it was necessary to ensure that sudden changes of flow would not be caused as a result of stopping and starting the turbines. An interval of three hours will elapse before an alteration of control at the canal intake will be felt at the power station, so that a spillway with the same capacity as that of the six turbines constitutes an essential part of the design.

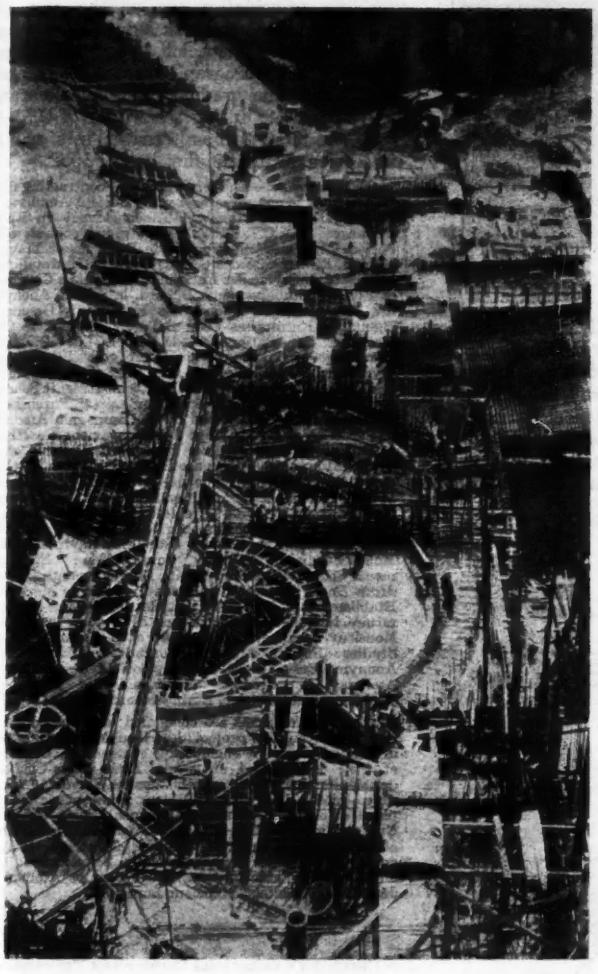
This spillway consists of six sluices, each controlled by a sector gate, covering an opening of 5·2m wide and 2·7m high, at the bottom level of the head race canal. Each sluice has a capacity of 255 cubic meters per second, which is equal to that of one of the Kaplan turbines. The spillway channel of each sluice is furnished with projecting teeth to dissipate the energy of the overflow water. Vents are provided to aerate the channel to avoid cavitation, and the stream bed downstream of the spillway is protected with rip-rap. To discharge floating debris a sluice gate 5·2m wide and 5m high is installed over each of the two end bays of the spillway at reservoir level.

The Lock

The design of the lock presents a number of points of unusual interest. The difference in level of 26m between the two canals is believed to constitute the greatest height of any lock yet built. It has been necessary to develop lock gates of a novel type and to incorporate a carefully designed system of inlet and outlet flow to make the lock function satisfactorily under this large head. It has a length of 195m, a width of 12m, and a minimum depth of 2·6m. Should the need be felt, it will be possible to construct a second lock adjacent to it at a later date.

The accompanying diagram, Fig. 30, shows the system of inlet and outlet adopted for the lock. There are, in fact, two such systems, one for each half of the lock, since provision has been made for the installation of an intermediate mitred gate. When the entire lock is in use, both systems will work simultaneously. During filling and emptying, the flow reaches a maximum of 100 cubic metres per second, with a mean change of level of 1·6m per minute, and a maximum of 2·3. Extensive model tests were carried out to ensure the avoidance of excessive turbulence, which would be dangerous to navigation. The sluices into the lock are arranged so that during filling the inflowing current will reach all points of the lock at the same time, thus avoiding any difference of level within the lock itself. The intake for supplying the lock is in the power station canal, and similarly water is drained off into the tail-race through the spillway structure and not into the downstream navigation canal.

The lock gates, which were specially developed by Professor Caquot, are segmental in form, the upstream gate forming in plan a minor arc of a circle, and the downstream gate being semi-circular. The upstream gate is opened by lowering it. The downstream end of the lock is masked by a wall of reinforced concrete between the levels of 43·50 (7m above the highest navigable level downstream) and 60·0. The downstream gate closes a space between the sill of the lock at 29·00 and the reinforced concrete mask at 43·5. This gate is raised to open; it is situated just downstream of the reinforced concrete mask, and is supported on guide rails. These guide rails are cast in the concrete on either side of the lock, and the gate bears against them through a series of spring-mounted



Figs. 27 and 28—Power Station, Spillway and Lock Ensemble

rollers. Thus when the pressures on each side of the gate tend to equalise, the spring loading pushes the gate in an upstream direction, so that it lifts in a similar manner to a conventional vertical lift gate.

The gates are placed with their concave face upstream, so that the hydrostatic forces which they resist are taken up by tension in the gates. It is of interest to note that a gate constructed on similar principles, though on a much smaller scale, for the closing of a sluice, has recently been developed independently in England.*

No fixed moorings will be provided in the lock, but eight floating bollards will be installed. From the formation up to a level of about 450, the lock is built in sandstone rock, and has side walls of comparatively light construction. Above this level the walls are 2m thick and heavily reinforced and are tied back into the surrounding ground.

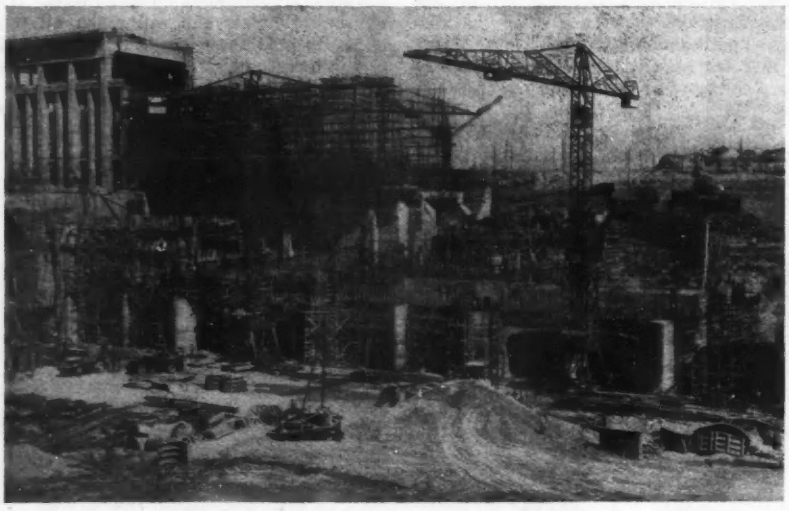


FIG. 29—CONSTRUCTION OF TURBINE FOUNDATIONS

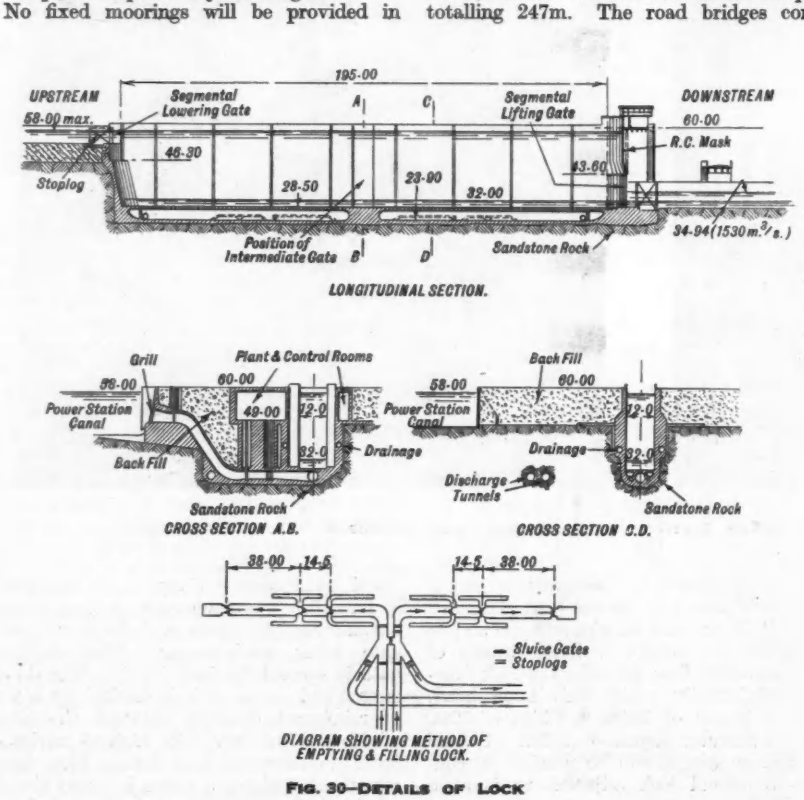


FIG. 30—DETAILS OF LOCK

Communications and Other Works

The re-establishment of communications over the route of the canal has necessitated major road and rail diversions and, as already mentioned, the building of nine large bridges. Seven of these are road bridges and two are railway bridges. Both the railway bridges are of steel lattice-girder construction, one having four spans, totalling 178m, and the other three continuous spans, totalling 247m. The road bridges consist of four suspension bridges with total lengths between 200m and 150m and three reinforced concrete bridges with lengths up to 260m.

A second major work of a subsidiary nature has been the realignment of the various tributaries of the Rhone, which flow into the left bank over the length of the canal, in such a manner that no harm will be caused to the irrigation of the surrounding agricultural land. An existing irrigation canal, the St. Pierrelatte canal, dating from the days of Louis XIV, has been led under the head-race canal by an inverted siphon of reinforced concrete pipes of large diameter, for the irrigation of the land between the canal and the river. Other diversions and siphons have been provided under the canal for the various tributaries. The River La Berre will be led into the head-race canal after passing through intake works designed to remove solid material, and the Lauzon River will be directed into the tail-race canal downstream of the power station, the Pierrelatte canal passing under this diversion in a pipe-line.

The various companies, which are responsible to the Compagnie Nationale du Rhone for the principal works of the Donzere-Mondragon scheme, both as contractors and as designers of specialist equipment, are listed in the paragraph below. It is envisaged that the gradual filling of the canal will take place during the winter of 1951–52 and the first turbo-alternator sets will be in service during the first half of 1952.

(1) *Contractors.*—There is a group of contracting firms whose work is co-ordinated by the Société Auxiliare de Co-ordination des Travaux d'Aménagement du Rhône à Donzere (S.A.C.T.A.R.D.). The group consists of la Société Française d'Entreprise de Dragages et Travaux Publics, l'Entreprise des Grands Travaux Hydrauliques, la Société Anonyme des Anciennes Entreprises Chagnaud et Fils, les Etablissements Billiard la Société Anonyme des Entreprises A. Monod, les Entreprises Ossude et Blanc, les Entreprises Léon Ballot, la Société de Construction des Batignolles, la Société de Dragages, Dérochage et Transports, la Compagnie d'Entreprises Hydrauliques et de Béton Armé, les Entreprises Industrielles et de Travaux Publics, les Etablissements Schmid, Bruneton, Morin, la Société Ossude. (2) Purchase of all materials is carried out by la Compagnie Auxiliare de Matériel et de Travaux d'Aménagement du Rhône a Donzere. (3) *Hydraulic Equipment, Power Station,* Turbo Alternators: A consortium of Alsthom, Ateliers des Charmilles, Compagnie de Fives-Lille and Escher-Wyss. Principal cranes, gantries and cofferdams: Etablissements Dayde. Architect: Monsieur Sardnal. Intake Grills: Etablissements Joya. *Spillway:* Etablissements Dingler. Model Studies: Neyrpic. *Lock:* Model Studies: Neyrpic. Construction: Etablissements Schmid Bruneton Morin, Etablissements Dingler. *Main Dam:* Société des Grands Travaux de Marseilles, Etablissements Joya Chabert. Model Studies: Laboratoire Nationale d'Hydraulique à Chatou. Architect: Monsieur Laprade. *Sluice Gates of Barrages:* General Studies: Société Anonyme Conrad Zschokke, Société Anonyme Buss. Construction: Société des Forges et Ateliers du Creusot Compagnie de Fives-Lille, Etablissements Dingler, Etablissements Dayde.

The following firms are concerned with the construction of the Seyssel project described in No. II of this article:—Main civil engineering contractors, Schneider et Cie.; compressed air work, Etpse Joya-Chabert; double-lift sluice gates, Etablissement Dayde; Aubert sluice gates, Babcock and Wilcox; automatic control panel of Aubert gates, Etablissement Saint Chamond Granat; power station, general hydraulic, mechanical and electrical contractor, "Materiel Electrique S.W."; sub-contractors for hydraulic work, Schneider et Cie. and Neyrpic; transformers, Les Forges et Ateliers de Jeumont. Architect, Monsieur Laprade.

Children's Christmas Lecture on Electricity.—In our issue of December 8th (page 576) we gave notice of the Christmas Lecture for Children arranged by the Institution of Electrical Engineers. Unfortunately, Dr. W. Wilson, who was to have given the lecture on "The Electric Current, its Action and Nature," is indisposed. We learn that the lecture will, therefore, be given by Mr. H. G. Jenkins, of the research laboratories of the General Electric Company, Ltd. His subject will be "Light and Colour."

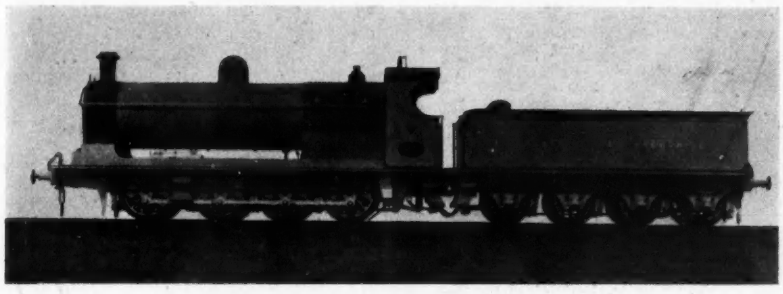
Automatic Stoking Plant.—In reply to a recent question in the House of Commons, Mr. P. Noel Baker (Minister of Fuel and Power) stated that, at the request of his department, the Combustion Engineering Association had set up a special national committee to encourage the further development of automatic stoking plant. The committee would prepare a comprehensive manual of information for the guidance of potential customers, giving them full information about the various kinds of plant and about the range of available coals suitable for each. The committee, which is under the chairmanship of Mr. H. E. Pearsall, includes representatives of the National Coal Board, of the manufacturers and users of plant, and of the coal distributors.

* See The Engineer, April 7, 1950, page 427.

Locomotives of 1900

By E. C. POULTNEY, O.B.E., M.I.Loco.E.

LOOKING back on the closing years of the last century, notable events are brought to mind in the history of British locomotives, not the least of which was the entry of strangers into our midst in the form of a number of American-built engines for service on British lines—a unique event and one well worth recalling.



ASPINALL'S EIGHT-COUPLED FREIGHT LOCOMOTIVE

Aside from these, British-built locomotives of the period—fifty years ago—included developments in the design of freight locomotives, while for passenger traffic no little interest was aroused by the reintroduction of the "single" driver, which may almost be said to have staged a "come back" though it proved to be short-lived.

By way of contrast with the "singles," a further locomotive which attracted attention is seen in James Holden's four-coupled express "Claud Hamilton," built for the Great Eastern at Stratford in 1900, and exhibited at Paris in the same year. We will glance at the British-built engines first of all, and look at the Americans later. The new freight engines were the first of the eight-coupled tender type built by British railways since its inauguration by F. W. Webb at Crewe in 1892. They were designed by Sir John Aspinall at Horwich for the Lancashire and Yorkshire, and at Doncaster by H. A. Ivatt for the Great Northern Railway.

As seen in the accompanying illustrations, the two engines were, in general, very similar, both being of the two-cylinder type and having the 0–8–0 wheel arrangement. A feature of both was the entire absence of balance weights of any kind to take care of the revolving and reciprocating parts. Presumably, balancing was considered unnecessary on account of the use of inside cylinders, combined with the relatively slow speeds of the trains handled. It is interesting to note, in passing, how Aspinall and Ivatt, working independently, once again did the same thing at much the same time, for a little earlier Ivatt produced the first British 4–4–2 tender engine, to be followed immediately by Aspinall, who built at Horwich an engine with the same wheel arrangement, as chronicled by the writer in THE ENGINEER of July 16, 1948, and July 29, 1949. The two 0–8–0 engines, which were quickly followed on other lines by further examples of the same general design, were referred to in greater detail in an article dealing with the development of eight-coupled freight engines on British railways, contributed by the writer to THE ENGINEER, May 4 and 11, 1945.

Lancashire and Yorkshire and Great Northern, Freight Engines, Type 0–8–0, 1900

	L. & Y.	G.N.R.
Cylinders:		
Diameter and stroke, inches	20×26	19½×26
Driving wheels diameter, feet and inches	4 6	4 8
Heating surfaces, square feet:		
Tubes	1877	1302
Firebox	161	136·75
Total	2038	1438·75
Grate area, square feet	26	24·5
Steam pressure, lb per square inch	175	175
Engine weight, tons:		
On drivers	53·77	54·61
Total	53·77	54·61

The illustration of the L. and Y. engine differs slightly from the original, as built, by having Pop safety valves in place of the Ramsbottom type, and that of the G.N.R. engine shows a superheated version.

THE SINGLE-DRIVER LOCOMOTIVES

The single-driver locomotives which appeared in 1900 were of three designs for the Midland, Great Northern and Great Central Railways respectively, the two latter being new, while the Midland engines were a further and final development of the type first built at Derby from S. W. Johnson's designs in 1887.

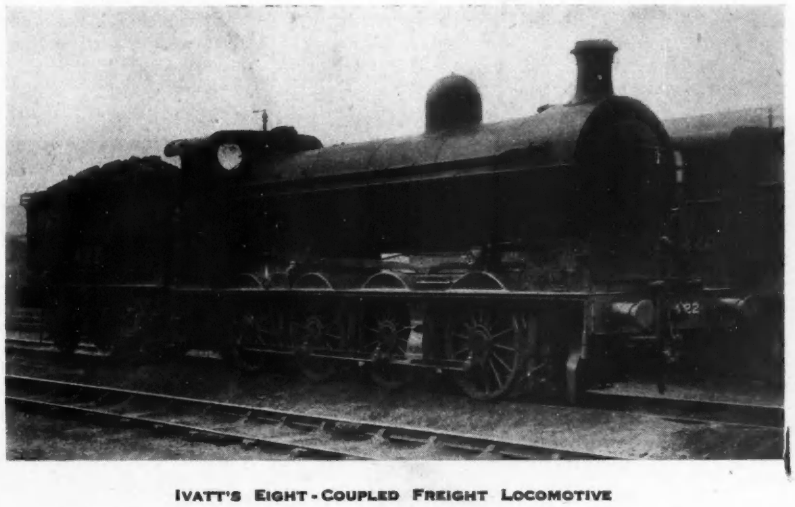
Before referring to the Midland "singles" of 1900, one of which, No. 2601, "Princess of Wales," is illustrated, a brief reference may be made to the evolution of these famous engines. The leading dimensions of the type are given in the table. The original design of 1887 set the pattern for the four succeeding classes, for all had the same design of main frames incorporating outside journals for the rear axle, and both inside and outside journals for the driving axle, while at the leading end an Adams bogie was employed.

The earlier engines of 1887 and 1889 differed but little except in the dimensions, as shown. The cylinders had their valves between operated by Stephenson's gear, and thus followed very general practice at that period. When, however, the next series came out, in 1893, an important modification was tried, when some of the engines then built were given cylinders of a new pattern, having piston valves. In other respects, these three successive designs were much alike save for changes in the cylinder and driving wheel dimensions. The same boiler was used, but modifications in the tube arrangements caused changes in the tubular heating surfaces. In 1897 a further new design appeared of larger dimensions, notably in the size of the driving wheels and the boiler, which had a larger firebox with increased grate area.

Piston valves were fitted, and the working steam pressure was raised from 160 lb to 170 lb per square inch. The piston valves used were of the type introduced on the North-Eastern and employed for various locomotive classes built by Wilson Worsdell at Gateshead. The principle of these valves, invented by Walter M. Smith, of the Gateshead Works, was the use of segmented collapsible rings, the object of which was to allow of the release of any water trapped in the cylinders. At that time the valves were usually placed below the cylinders with their axis inclined upwards and at sufficient transverse distance apart to permit their being operated direct by the valve gear. Outside admission valves were used so that, with the exhaust between the valve heads, a very direct passage

Midland "Singles," 4–2–2 Type Locomotives. S. W. Johnson, Derby, 1887–1900

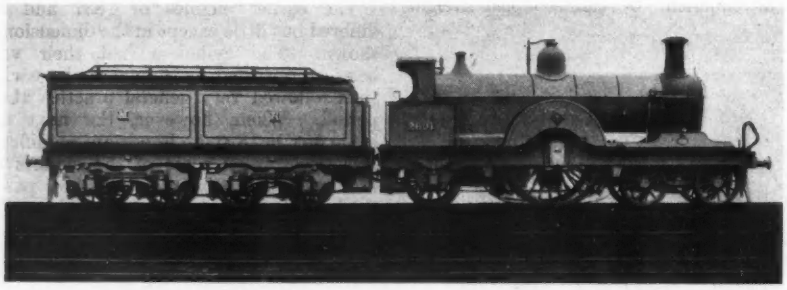
Date	Cylinders, diameter and stroke	Driving wheels, diameter	Heating surfaces, Tubes	Heating surfaces, Firebox	Heating surfaces, Total	Grate area	Steam pressure	Engine weight, On drivers	Engine weight, Total
	In	Ft in	Sq ft	Sq ft	Sq ft	Sq ft	Lb/sq in	Tons	Tons
1887	18 ×26	7 4	1123	117	1240	19·5	160	17·5	43·20
1889	18½×26	7 6	1123	117	1240	19·5	160	18·0	44·20
1893	19 ×26	7 6	1106	117	1223	19·5	160	18·0	44·20
1897	19½×26	7 9	1105	128	1223	21·3	170	18·5	47·10
1900	19½×26	7 9½	1070	147	1217	24·5	180	18·1	50·15



IVATT'S EIGHT-COUPLED FREIGHT LOCOMOTIVE

to the blast pipe was readily obtained.

For use with these valves an automatic air and steam valve was designed to prevent the formation of a vacuum in the steam chests when running with the regulator closed. This arrangement consisted of a large diameter flat valve resting on a seating and kept tight by steam pressure when running with steam on. When coasting, however, if a vacuum was formed in the steam chests, atmospheric pressure lifted the valve, thus allowing air to enter, and at the same time a small valve was opened, allowing steam from the boiler also to enter the steam chests and of sufficient quantity to lubricate the valves and pistons and at the same time to cushion the latter at the end of their stroke.



JOHNSON'S MIDLAND SINGLE-DRIVER EXPRESS LOCOMOTIVE

The piston valve engines built at Derby in 1897 and the later series of 1900 were equipped with their valves, arranged as above described, and also with Smith's pattern of automatic air and steam valves.

Referring further to the Midland singles of 1900, the dimensions given in the table show that, as in the case of those built in 1897, the boiler capacity has again been augmented by adding to the size of the firebox and increasing, at the same time, the area of the grate, though the cylinder dimensions remained as before. The steam pressure is also higher at 180 lb per square inch. The engine of this class, illustrating one of the last of Johnson's famous "singles," was shown at Paris in 1900 with Holden's "Claud Hamilton" 4–4–0 (illustrated here) and F. W. Webb's four-coupled, four-cylinder, compound locomotive "La France," and was awarded a Grand Prix. Mention may here be made of the fact that one of Johnson's earlier "singles," as built in 1889, was also exhibited in Paris at that time, and also gained a similar award. The Midland single-wheelers enjoyed in their day considerable admiration, being certainly distinguished by a graceful outline peculiar to Derby practice of the period.

Johnson was (to quote from his obituary in the issue of THE ENGINEER of January 19, 1912) "a stickler for beauty," a remark with which there will be general agreement. When, however, it is recalled that S. W. Johnson received his early engineering training with E. B. Wilson and Co., the creators of that masterpiece "Jenny Lind," the symmetrical proportions of his own creations are in no way surprising.

The Great Northern single-wheelers of 1900 did not, strictly speaking, inaugurate an entirely new departure, because, as a matter of fact, Ivatt had already built a "single" of the 4–2–2 type earlier in 1898. One engine, however, only was then built,

Great Northern and Great Central "Singles," 4–2–2 Type Engines, 1900

	Railway	
	G.N.R.	G.C.R.
Cylinders :		
Diameter and stroke, inches ...	19×26 ...	19½×26
Driving wheels diameter, feet and inches	7 8 ...	7 9
Heating surfaces, square feet :		
Tubes	1143·8 ...	1062
Firebox	125·8 ...	132
Total	1269·6 ...	1194
Grate area, square feet	23·2 ...	24·8
Steam pressure, lb per square inch ...	175 ...	200
Engine weight, tons :		
On drivers	17·75...	18·35
Total	48·55...	47·25

followed by eleven others of the same type, but of modified dimensions, in 1900. The Ivatt engines differed from the Midland in having inside bearings only for the driving axle, and the inside cylinders had balanced slide valves on the top, operated by Stephenson's gear through rockers.

The Great Central engines designed by Harry Pollitt were entirely new and differed from the Midland and the G.N.R. engines by having inside bearings for all axles and Belpaire boilers. The cylinders, between the frames, were a copy of those used by Johnson for his piston valve engines, and the valves themselves were of the Smith pattern.

In building these "singles" H. Pollitt revived a much older Gorton design of 1882 for the Manchester, Sheffield and Lincolnshire, originated by Charles Sacré. These were, however, of the 2–2–2 type with outside cylinders, and the new engines, with their cylinders inside and a leading bogie, were, in consequence, no doubt more suited for high-speed running. The Ivatt "singles" on the G.N.R. followed, of course, those built by Patrick Stirling, resembling more particularly his 2–2–2 inside cylinder class. Here, again, the new locomotives were probably an improvement with their leading bogies and larger boilers, the respective heating surfaces being 1269 and 1045 square feet.

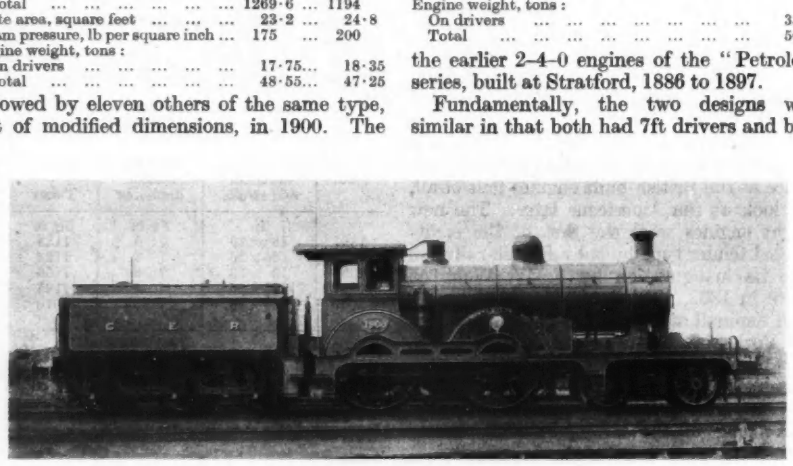
HOLDEN'S FOUR-COUPLED EXPRESS

The Great Eastern passenger engines of the "Claud Hamilton" class were built to work the main line express trains in place of the earlier 2–4–0 engines of the "Petrolea" series, built at Stratford, 1886 to 1897.

Great Eastern, 4–4–0 Type Passenger Locomotive "Claud Hamilton," No. 1900

	G.E.R.
Cylinders :	
Diameter and stroke, inches...	19×26
Driving wheels diameter, feet and inches ...	7 0
Heating surfaces, square feet :	
Tubes	1516·5
Firebox	114
Total...	1630·5
Grate area, square feet	21·3
Steam pressure, lb per square inch	180
Engine weight, tons :	
On drivers	33·22
Total	50·41

Fundamentally, the two designs were similar in that both had 7ft drivers and both inside cylinders of similar design, characterised by having their slide valves below, working on faces inclined upwards so that they could be operated direct by Stephenson's gear common to both designs.



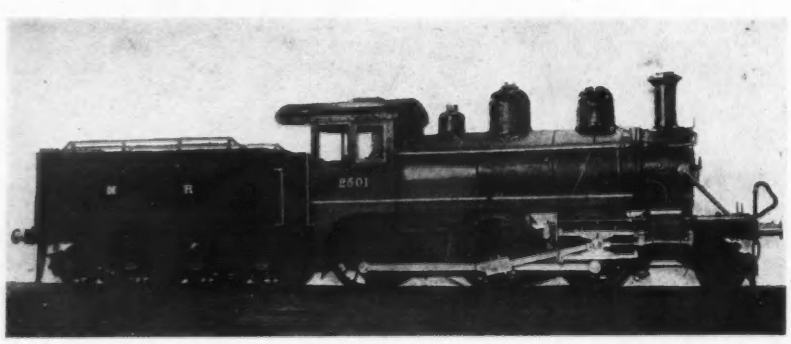
HOLDEN'S FOUR-COUPLED EXPRESS ENGINE "CLAUD HAMILTON"

The new engines constituted a considerable advance in power, however, with their larger cylinders and boilers having extensive heating surfaces, in which respect they followed the lead set by J. F. McIntosh on the Caledonian. The photograph reproduced shows these locomotives to be of pleasing appearance, a feature which, together with the design as a whole, gained the engine "Claud Hamilton" a well-deserved award at the exhibition in Paris.

THE AMERICAN LOCOMOTIVES

During the years 1899 and 1900, a number of American-built locomotives appeared on the Midland, Great Northern and Great Central lines.

For these railways a total of eighty engines were supplied by firms in the United States,

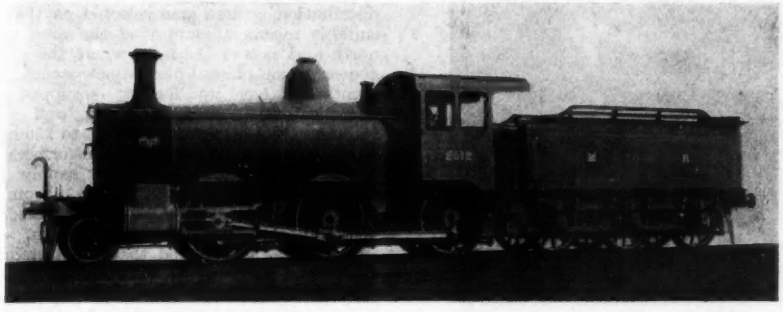


MIDLAND 2-6-0 ENGINE—BURNHAM WILLIAMS AND COMPANY

of which the Midland received forty, the G.N.R. twenty, and also twenty for the G.C.R. The firm of Burnham, Williams and Co., Baldwin Works, Philadelphia, Pa., built seventy engines—thirty for the Midland and twenty each for the other two lines—and for the Midland a further ten were supplied by the Schenectady Locomotive Works, Schenectady, N.Y.

All these engines were of the 2–6–0 type, and were intended principally for freight traffic. With the exception of certain special features, such as copper in place of steel fireboxes, side buffers, drawgear and vacuum brake apparatus, the design was purely American. The cylinders were cast with half saddles, had their steam chests above and balanced slide valves, operated by Stephenson's gear, between the frames through rockers, thus resembling usual American practice of the period. The Philadelphia engines were all much alike and of generally similar dimensions. Those built at Schenectady, while of closely the same dimensions as the Burnham, Williams engines, differed in appearance and had six-wheeled tenders of distinctly British design. The 2–6–0 wheel arrangement, though at one time very common in American practice, had scarcely been used on British railways; in fact, those built at Stratford for the Great Eastern by Massey-Bromley in 1878—which, by the way, were somewhat American both in appearance and detail design—were the only representatives of the type till those of 1899–1900 arrived.

Other American-built locomotives supplied to British railways about 1900 included two of the 0–8–2 type for the Port Talbot and five 0–6–2 engines for the Barry. These were all tank engines, and were built by the Cooke Locomotive and Machine Company, Pattison, New Jersey, U.S.A. The illustrations of the American locomotives have been produced from photographs kindly furnished by the American Locomotive Company and the Baldwin Locomotive Works, and those of the other engines are from photographs supplied by the Locomotive Publishing Company.



MIDLAND 2-6-0 ENGINE—SCHENECTADY LOCOMOTIVE WORKS

American Locomotives, 1899–1900, *Principal Dimensions. Schenectady Locomotive Works, Schenectady, N.Y.*

	Midland
Type	2–6–0
Cylinders, diameter and stroke, inches	18×24
Driving wheels diameter, feet and inches	5 0
Steam pressure, lb per square inch	160
Heating surfaces, square feet	1255·33
Grate area, square feet	15·87
Weight on drivers, tons	39·7
Engine weight, tons	47·6

Burnham, Williams and Co., Baldwin Works, Philadelphia, Pa.

	Midland	G.N.R.
Type	2–6–0	2–6–0
Cylinders:		
Diameter and stroke, inches	18×24	18×24
Driving wheels diameter, feet and inches	5 0	5 1½
Steam pressure, lb per square inch	180	175
Heating surfaces, square feet	1372·4	1380·0
Grate area, square feet	16·6	16·7
Weight on drivers, tons	37·09	37·5
Engine weight, tons	44·79	45·09

Extensions to The Pangani Hydro-Electric Scheme

AN important East African hydro-electric generation and transmission scheme centred on the Pangani Falls in Tanganyika has recently been extended, and now supplies more power to the important sisal plantations in the valley of the River Pangani. The preliminary plans, based on a survey carried out by the Power Securities Corporation, Ltd., were submitted to the Tanganyika Government for approval in 1930. By 1936, the Tanganyika Electric Supply Company, Ltd., had completed the first stage of the project. A hydro-electric power station had been built below the Pangani Falls, and an extensive distribution network had been completed. The alternators and much of the switchgear were manufactured and installed by the General Electric Company, Ltd., of England. Additional generating plant has recently been commissioned bringing the total capacity of the power station to 12,500kW, and a further 5000kW alternator is now on order.

As shown by Fig. 1, the River Pangani rises on Mount Kilimanjaro (19,320ft), whence it descends to a plateau approximately 1000ft above sea level. On its way the river passes through a considerable area of swampy ground from which rapid evaporation takes place in the tropical heat. Owing to the nature of its source and its passage through marshy areas, the river does not show the great fluctuations in volume which are encountered in most rivers in tropical countries. The main falls occur about 45 miles inland from Tanga. Their total drop, which is about 400ft, takes place in a series of rapids and falls over a distance of approximately two-thirds of a mile, none of the individual falls being of any great height.

The power station is situated below the falls in a part of the country which is difficult of access. The Tanga-Moshi railway passes within about 10 miles of the site and, from the railway, a rough jungle road leads to one bank of the Pangani River. The power station, however, had to be built on the opposite bank and, until the new bridge was opened in January, 1946, all material had to be transported across the river on a barge or pontoon.

A channel of the river to the east of the falls furnished a suitable position for the intake works, and a twin pipe-line, 1240ft long, leading from this point to the power station below, gives a head of 313ft. For the first 418ft the pipes are 6½ft in diameter, after which they are reduced to 6ft, with the aim of lessening hydraulic friction in the upper section. The intake to the pipe-line comprises a mass concrete structure in which are set six scour sluice gates to remove any debris which may accumulate. In the initial stage, only one pipe-line was installed, but provision was made for the second, which was completed in 1949.

Power-House

The power-house itself, Figs. 2 and 3, is a steel-framed building covered with asbestos cement and galvanised iron sheeting. The plant at present installed in the generating room shown in Fig. 3 consists of four 6·6kV, three-phase, 50 c/s, G.E.C. alternators, three of which are rated at 2500kW and one at 5000kW, each provided with a main exciter and a pilot exciter. These machines are driven at 750 r.p.m. by Francis horizontal-shaft turbines, built by Boving and Co., Ltd., the smaller machines being single-runner units, rated at 3600 h.p., whilst the larger is a double-runner unit rated at 7200 h.p.

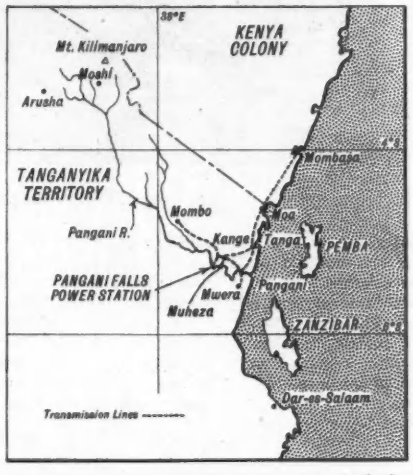


FIG. 1—PANGANI HYDRO-ELECTRIC SCHEME

Because of the high speed of the generating sets, a special design of alternator was adopted in which each of the eight poles is dovetailed into the rotor forging and forced into position under hydraulic pressure. Since the maximum load that could be handled over the 10 miles between the railway siding and the power station was 12 tons, the poles of the 5000kW alternator were removed from the rotor after the machine had been tested at the works and were despatched as separate loads. The poles were refitted to the rotor in the power station. Again, because of weight limitations, the stator of the 5000kW machine was manufactured in two halves and, after passing the works' test, twenty coils were removed adjacent to each joint to enable the stator to be despatched as two loads. The coils were refitted on site.

On each of the 2500kW machines (Fig. 4) the two pedestal bearings are water cooled, the turbine runner being mounted on an overhung portion of the alternator shaft. At this end of the alternator, a Michell bearing is used to take the thrust. At the other end of the alternator is the main exciter. The pilot exciter is mounted on a shaft extension overhung from the main exciter. The rotor of the 5000kW alternator runs in its own water-cooled pedestal bearings, and is solidly coupled to the flywheel and to the turbine shaft which also runs in two water-cooled pedestal bearings, one of which is a Michell thrust bearing. Propeller fans of special design to give axial ventilation are used for cooling the alternators. The cooling air is taken from outside the building during dry weather and from inside the building

at other times, and is discharged through ducts in the concrete below the machines.

The output of the four alternators is controlled by a 6·6kV cubicle switchboard installed in the gallery. This board also controls three outgoing feeders to transformers which step up the voltage to 33kV for transmission by an overhead system. Each circuit is equipped with an oil circuit breaker, the board being provided with duplicate busbars and two sets of busbar isolators on all circuits so that the circuit breakers may be connected to either set of busbars. In the centre of the board is a bus coupler panel arranged to couple the busbars together through an oil circuit breaker and isolators, thus enabling "on-load" changeover to be carried out between busbars. Mounted on the left-hand end of the board is a swing panel carrying the synchroscope, synchronising voltmeters and frequency meter. Each alternator panel is equipped with an indicating wattmeter, ammeters and a watt-hour meter, and with protective relays including a triple-pole overload relay, a relay for the protection of the alternator windings and cables, and over-voltage and over-frequency relays. As the plant is operated by Asiatic attendants, a very comprehensive system of interlocks is provided which not only prevents access being obtained to the interior of the cubicles, until all associated apparatus is dead, but also prevents incorrect switching during synchronising and changing over from one set of busbars to another.

FIG. 2—PANGANI POWER STATION FROM THE RIVER

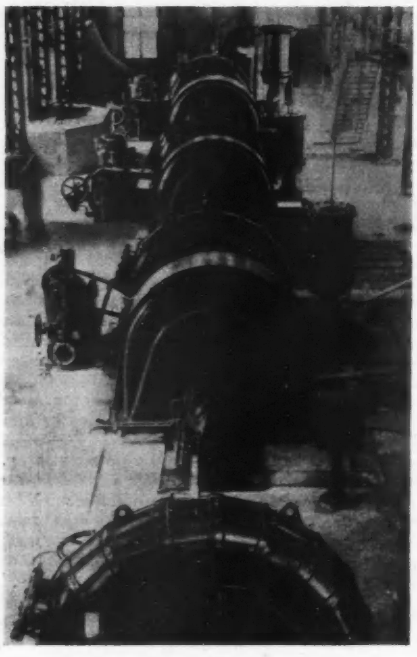


FIG. 3—GENERATOR ROOM

Each alternator is controlled from an exciter desk which is equipped with a d.c. ammeter and voltmeter, an automatic voltage regulator and hand regulators for the main and pilot exciters. A field discharge pillar is also installed. Line voltage compounding equipment is provided, current transformers in each feeder cubicle being connected to a tapped transformer on which the desired tapping is selected by means of a master controller. The secondary of the tapped transformer is connected to the voltage regulator for each machine through a rheostat by means of which the degree of compounding applied to each alternator may be adjusted. The feeder transformers are provided with 400V tertiary windings, two of which are normally connected through isolating transformers to a flat-back distribution board which is arranged for three-phase, four-wire operation. This low-tension supply is controlled by electrically operated oil circuit breakers. Triple-pole overload and earth leakage protection is provided on the incoming panels of the board. A number of two-wire and four-wire supplies are taken from this board and are controlled by switches and fuses. In addition, there are two rectifier panels, a battery panel, and a d.c. feeder panel, the d.c. supplies being used for auxiliary purposes, such as for operating circuit breakers.

DISTRIBUTION SCHEME

The principal power demand comes from the sisal factories which are scattered throughout the area, the growth and decortication of sisal for twine and cordage being Tanganyika's most important industry. The port of Tanga is also an important consumer, and, recently, Mombasa township and the adjoining harbour at Kilindini were connected to the Pangani Falls power station by an overhead line carried through some 90 miles of difficult bush country from the substation near Tanga. A 33kV ring main distribution system was selected as the most suitable means of supplying the area to the north and east of the falls, where the greatest concentration of sisal plantations occurs. Each plantation has its factory equipped with decorticators, pumps, brushing and baling machines, requiring from 120 h.p. to 250 h.p. to drive them. Step-down transformers are installed at various points to supply 11kV feeders and further ring mains. From this 11kV system, local distribution is effected on a 400/230V, three-phase, four-wire system.

It will be appreciated that the terrain, the absence of good roads, the resulting difficulty of transport—particularly during the heavy rains—and the unhealthy climate, all combined to make the construction of the overhead lines a matter of unusual difficulty. Clearings had to be cut through the forest, not only for the transmission line right-of-way, but also to provide means of access for the constructional materials. The reinforced concrete poles, which are 36ft in overall length and each of which weighs nearly a ton, presented a particularly difficult transport problem. The work was carried out by Balfour Beatty and Co., Ltd., of 66, Queen Street, London, E.C.4, who was responsible for the whole of the design of the scheme and for its construction.

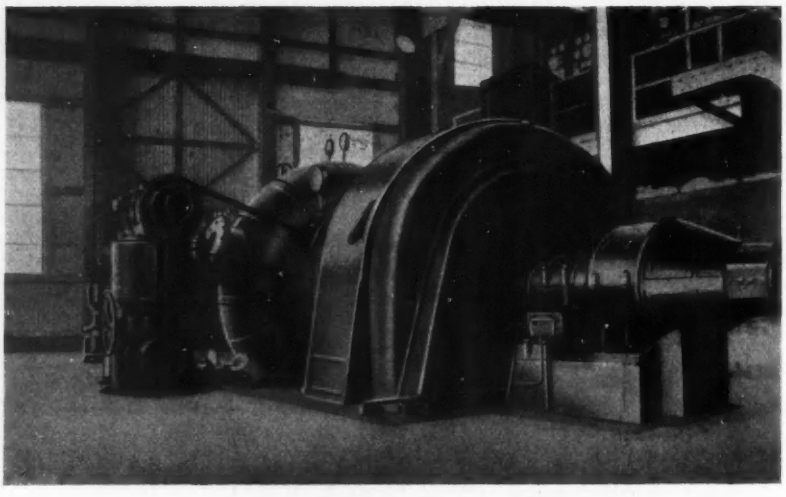


FIG. 4—2500KW TURBO-ALTERNATOR SET

THE PHYSICAL SOCIETY'S EXHIBITION.—The Physical Society's thirty-fifth annual Exhibition of Scientific Instruments and Apparatus will be held from Friday, April 6, to Wednesday, April 11, 1951, excluding Sunday. Both the Royal College of Science Main Building, Imperial Institute Road, and the Huxley Building, Exhibition Road (opposite Science Museum) will be used. On Friday morning the Exhibition will be open for members of the Society and the Press only, and all tickets will be valid for entry into both buildings. Discourses will be delivered by eminent scientists on four days of the Exhibition, and the prize-winning models of the Society's Craftsmanship and Draughtsmanship Competition will be on show. This competition, which is open to apprentices and others under the age of twenty-two years, is organised by the Physical Society, 1, Lowther Gardens, Prince Consort Road, London, S.W.7, to stimulate the interest of young craftsmen and draughtsmen in industrial firms, technical colleges and Government departments.

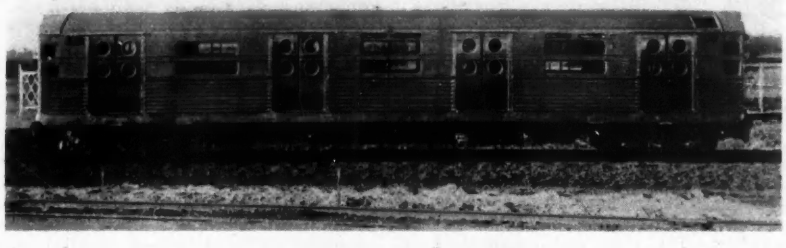
Stainless Steel Trains for New York Subways

WITH the introduction recently of a number of stainless steel trains of greatly improved design and appearance, the Board of Transportation of the City of New York has begun to extend to its 7,000,000 daily "Subway" travellers a service which compares quite favourably with that offered by London's underground railway system. The new carriages were planned and designed by engineers of the Board in collaboration with the manufacturer, the Budd Company, of Philadelphia. They are 60ft long, 10ft wide, 12ft high, and have four electrically controlled 50in wide double doors per side. Each vehicle has a weight of 37 tons and a seating capacity of fifty-four and can attain a speed of 45 m.p.h. The new carriages differ from all other New York Subway rolling stock in many important details, which have been incorporated in the new design to increase carriage life, appearance and passenger comfort and convenience. The car bodies are of stainless steel with the exception of the body bolsters, which are welded sections of low-alloy high-tensile steel. Thanks to the high strength-weight ratio of stainless steel and the use of the Budd Company's "Shotweld" method of resistance-welded fabrication, the new carriages are considerably lighter than older models, without any sacrifice of safety. The interior colour scheme has been worked out to produce a harmonious blending of floor, walls, ceiling and seats. Stainless steel trim, hand rails and stanchions have been used for attractiveness as well as cleanliness. The number of stanchions along the centre of the carriage has been increased from four to ten to provide additional convenience for passengers. The stanchions at the cross seats and hand rails above the windows have been retained. Smooth riding qualities and general noise reduction have been obtained by the extensive use of rubber mountings in the bogies, by roller journal bearings and by horizontal and vertical shock absorbers to minimise bounce and to reduce swing and sway. There are four motors per carriage—one mounted on each axle. A specially designed controller provides high rate of acceleration, and operates a dynamic braking system to produce smooth and safe stops. The interior of the carriage is illuminated by fluorescent lighting operating on a.c. instead of the d.c. which is used in other subway vehicles. Power for this lighting system is obtained from an a.c. generator which also provides current for the operation of filtering units and air-sterilising lamps.

Ventilation of the car is obtained by a forced air system which combines recirculated and fresh air units that may be operated independently or combined. The recirculating air system consists of two double blowers mounted above the ceiling—one at each end of the car—each unit being operated by a single-phase motor. The blowers each have a capacity of 2660 cubic feet per minute when operated at normal speed. A thermostatically controlled contactor is provided to increase the blower speed to 2200 r.p.m. when high temperatures occur during the summer. The recirculating blowers draw the air from the interior at each end of the car through a grille in the ceiling. Four ultra-violet-ray sterilising lamps are mounted on the upper side of each grille. The blowers force the air into the ducts which are between the ceiling and the roof and into the vehicle through seven air outlets along the centre line of the ceiling, producing a non-draught distribution of air. During times when the recirculating blowers are not required, air is drawn from the interior of the carriage through distributors into ducts by blowers which are on the vehicle underframe. This air is filtered and sterilised and returned to the car interior from distributors placed underneath the longitudinal seats. The second or fresh air system provides 3000 cubic feet per minute of fresh air per vehicle, taken into a second duct system through grilles at diagonally opposite corners of the carriage at the roof. A thermostatically controlled damper regulates the amount of fresh air and recirculated air in the system. Two blowers are mounted underneath the vehicle and each has a capacity of 1500 cubic feet per minute. The air from each of these blowers passes through an air filter where it is precleaned and ionised, and the fine dust is deposited electrostatically on plates coated with a viscous material. The cleaned air passes over two sterilising lamps in each unit and is delivered through a duct system to the fourteen distributors situated underneath the longitudinal seats. Electric heating strip elements are mounted at the back of each of these distributors for heating the filtered and sterilised air when heat is required. The underseat distributors are designed to deliver the air in a flat 180 deg. fan-like pattern 2in above the vehicle floor. This pattern of heated air has been proved to maintain a warm, dry floor during the heating season.

CARRIAGE INTERIOR

A public address system is provided for station announcing or such other use as may be required. The system consists of two microphones per carriage, mounted on diagonally opposite corners of the vehicle; an amplifier pack, and five loudspeakers, three of which are installed in the overhead air distributors, and one bulkhead mounted at each end of the carriage. The system may be operated throughout the train from any one microphone position selected by the conductor. Two illuminated maps of the New York underground railways are provided in each vehicle, the illumination being arranged to "high-light" the route and stations on the line over which the train is being operated.



STAINLESS STEEL CARRIAGE

Large Swedish Tanker

RECENTLY the 24,000-ton tanker, "Tank Emperor," the largest ship of this class ever built in Sweden, was launched at Kockum's Shipyard in Malmö. This was a first ship of a new series of five ordered from the shipyard by Skips A/S Oilexpress, Sig. Herlofsson and Co., of Moss, Norway. The "Tank Emperor" is all-welded; she has two longitudinal bulkheads and twenty-four tanks, divided by three cofferdams and totalling 1,204,000 cubic feet; also a dry cargo hold of 35,000 cubic feet. The ship has a length between perpendiculars of 570ft, beam 77ft, moulded depth 42ft 9in and draft 31ft 10in. A seven-cylinder, two-stroke, double-acting Kockum-M.A.N diesel engine developing 7000 h.p., will give the tanker a service speed of 14 knots. For pumping the oil cargo there are installed in two pump-rooms three steam-driven cargo-oil pumps forward and aft of the bridge, with a capacity of about 425 tons per hour each.

Metallurgical Topics

Carbonitriding

CARBONITRIDING is the term applied to the process in which simultaneous absorption of carbon and nitrogen occurs at the surface of a case-hardening steel, heated in a suitable gaseous mixture at a temperature a little above the critical point. It is thus, in a sense, a compromise between carburising and nitriding, carried out at a temperature lower than that used for carburising, but higher than that employed in nitriding. Cementation or carburising is a process with a long history, but ever since its use as a means of case-hardening steel for engineering purposes efforts have been made to improve the process, to speed it up and to render it less liable to cause deformation, by introducing " energisers " or means for reducing time and temperature of treatment. A study of pack carburising indicated that a gas containing carbon (mainly as carbon monoxide

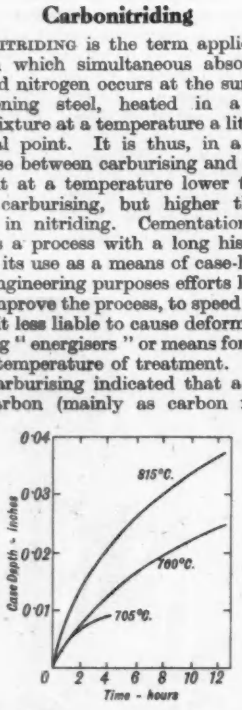
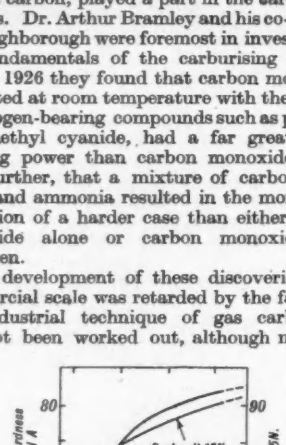


FIG. 1—*Depth of Case as a Function of Time of Carbonitriding at Different Temperatures (Rengstorff, Bever and Floe)*

and methane) was necessary for the transfer of carbon from the charcoal to the steel, but the action of other ingredients often employed in carburising mixtures implied that nitrogen, as well as carbon, played a part in the carburising process. Dr. Arthur Bramley and his co-workers at Loughborough were foremost in investigating the fundamentals of the carburising process, and in 1926 they found that carbon monoxide, saturated at room temperature with the vapour of nitrogen-bearing compounds such as pyridine and methyl cyanide, had a far greater carburising power than carbon monoxide alone and, further, that a mixture of carbon monoxide and ammonia resulted in the more rapid formation of a harder case than either carbon monoxide alone or carbon monoxide and hydrogen.

The development of these discoveries on a commercial scale was retarded by the fact that the industrial technique of gas carburising had not been worked out, although nitriding



The following are approximate equivalents :—

Rockwell 15N	Rockwell A	Vickers DPH
91	83	900
85	75	520

FIG. 2—*Surface Hardness as a Function of Carbonitriding Temperature Specimens Carbonitrided Four Hours and Oil-Quenched (Rengstorff, Bever and Floe)*

made rapid progress in the intervening years. Meanwhile, search was continually being made for improved " energisers " for pack carburising, and in this connection it was found that immersing steel in a bath of molten sodium cyanide rapidly produced a shallow but very hard case. This case was formed by the simultaneous absorption of carbon and nitrogen, and efforts were then directed to varying the proportion of these elements in the case. Activated cyanide hardening baths have been developed which promote carbon absorption while suppressing nitrogen absorption and produce a case resembling the normal carburised case rather than the cyanided case. On the

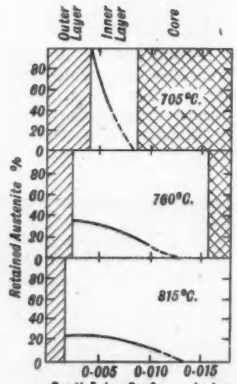
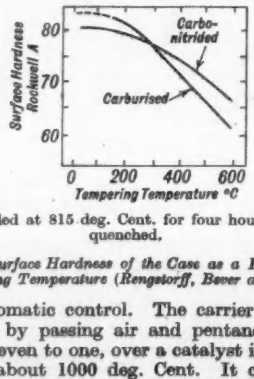


FIG. 3—*Retained Austenite in the Inner Layer of Specimens Carbonitrided Four Hours and Quenched in Oil (Rengstorff, Bever and Floe)*

other hand, steps have been taken to increase the nitrogen absorbed in relation to the carbon by bubbling dissociated ammonia gas through the molten salt bath (Chapmanising). This process gives a relatively thin case compared with carburising, but it is much faster than nitriding, and high hardnesses, claimed to approach those obtained by nitriding, have been reported.

Carbonitriding by mixed gases containing ammonia, methane and a " carrier gas " (consisting of carbon monoxide, hydrogen and nitrogen) is carried out under a variety of conditions, some of which have been studied by G. W. P. Rengstorff, M. B. Bever and C. F. Floe.* Regularity in properties of the case calls for close control of temperature, time of treatment and gas composition as well as of type of steel and of conditions of the final quenching operation. The steel used contained carbon 0·23, manganese 0·43, phosphorus 0·014 and sulphur 0·035 per cent. Case-hardening was carried out in an electric furnace equipped



Carbonitrided at 815 deg. Cent. for four hours and oil-quenched.

FIG. 4—*Surface Hardness of the Case as a Function of Tempering Temperature (Rengstorff, Bever and Floe)*

with automatic control. The carrier gas was prepared by passing air and pentane, in the ratio of seven to one, over a catalyst in a silica tube at about 1000 deg. Cent. It contained 31 per cent of hydrogen and 20·5 per cent of carbon monoxide. The gas composition used was ammonia 40, methane 10 and carrier gas 50 per cent, but considerable variation was permissible. The time and temperature of carbonitriding determine the depth of case produced, temperature being the most important single variable (Fig. 1). The maximum surface hardness increases with temperature of treatment (Fig. 2). The structure of carbonitrided cases shows an inner and an outer layer. The thickness of the outer layer decreases with increasing temperature of treatment, while that of the inner layer increases (Fig. 3). The outer layer formed in carbonitriding at 705 deg. Cent. consists of a mixture of cementite and the ε-constituent of the Fe-N-C system. At higher temperatures cementite only, containing nitrogen atoms substituting for carbon, was found. The nitrogen content near the surface decreases from approximately 1·5 per cent at 705 deg. Cent. to less than 0·4 per cent at 845 deg. Cent. The corresponding carbon contents were approximately 2·5 per cent at 705 deg. Cent., over 3·0 per cent at 760 deg., and 1·5 or slightly more at 815 deg. to 845 deg. Cent. Beneath this layer a nitrogen-carbon austenite is formed ; this decomposes into martensite and retained austenite, the amount of which is a function of the amount of nitrogen present, thus decreasing with increasing temperature (Fig. 4). The hardness of the outer layer is independent of the rate of cooling. Oil-quenching results in full hardening of the inner layer. When tempered at 300 deg. Cent. or above, specimens carbonitrided at 815 deg. to 845 deg. Cent. retain their hardness somewhat better than comparable carburised specimens (Fig. 4).

The authors of these papers sum up the claims made for carbonitriding, though they do not attempt to assess the merits of the process, as their work has related only to certain aspects of its development. Among the advantages claimed for carbonitriding are the following :—temperatures are lower than in carburising, there is less risk of distortion in the furnace, fuel costs are reduced and furnace maintenance simplified ; lower quenching rates are possible ; the working conditions are better and safer than in cyaniding ; the cases produced are more resistant to tempering than carburised cases, and they are stated by some authorities to be harder and more resistant to wear and to corrosion. Carbonitriding, like gas carburising, is readily applicable to mass production methods, and, if the change is desired, the conversion of gas carburising furnaces to carbonitriding is a simple matter.

Conservation of Niobium

IN 1933 Houdremont and Schafmeister proposed the use of titanium in austenitic chromium-nickel steels to secure immunity from intergranular attack. This method of stabilisation was widely used in England but various objections were raised to its use in the U.S.A. Meanwhile, the use of columbium (niobium) for this purpose was first described by Becket and Franks in 1934.

One of the objections to the use of titanium (later minimised by improved welding technique) was that it was removed from the deposited layers during fusion welding to such an extent that the weld metal ceased to be immune from local attack. Consequently steel stabilised by columbium, which was not readily oxidised or volatilised during welding, was used instead for welding rods. Inclusions, also, tended to be excessive in titanium-stabilised steels, and were a source of trouble, especially in connection with the production of tubes and of highly polished sheets. The success obtained with titanium as well as with columbium led, however, to the use of both these metals. In Britain, titanium was much more widely used than columbium and a large tonnage of austenitic stainless steel, stabilised by titanium, has been successfully employed in welded equipment subsequently exposed to nitric acid attack, and in America the reported adverse results were not upheld by all observers. However, in the U.S.A., steel stabilised by columbium (known as A.I.S.I., Type 347) was generally preferred to that in which titanium was used (Type 321).

Consideration has, of course, been given to the relative availability of titanium and columbium. As was recorded two years ago (*Metal Progress*, December, 1948) : " It may be well to ask whether the long-term view would not be to encourage the use of the element (titanium) that has given good performance over a period of years and that is in abundant supply in the earth's crust rather than a material (columbium) that may become scarce."

In view of the strategic importance of columbium and the more ample supply of titanium, numerous comparative tests have recently been made in America of steels stabilised by each of these elements. For example,

* American Society for Metals, 1950, Preprints No. 1 and No. 2.

a comparative evaluation of Types 321 and 347 as nozzle-blade materials in turbojet engines led to the conclusion that "based on resistance to cracking, no significant difference in engine performance exists between nozzle blades of the two types of steel."

The question, titanium or columbium, was taken up in its wider aspects by John F. Tyrrell, of the Solar Aircraft Company, in an article in *Metal Progress* for July, 1950. In this he urged the rather general substitution of titanium-stabilised steel for the columbium-stabilised grade. This article has been followed in the November number of the same journal by a most valuable account of British and American practice and experience, in the form of short contributions from fifty-six metallurgists, representing all the industries concerned, seventeen being British and the rest American. The evidence submitted and the views expressed have been considered by Mr. Tyrrell, the author of the original article, who has written a summarising statement from which a few sentences may be quoted :—

"The broad conclusion is that columbium-bearing alloys can almost always be replaced successfully by alloys containing less columbium or no columbium. Usage of less critical alloys is not only being discussed but is long-standing practice in Britain and is now being widely adopted in the U.S."

"Well-qualified discussers have pointed out that Type 321 steel is not only satisfactory for a great many uses in the chemical industry but, in particular, has given completely satisfactory service in many items of plant equipment serving in contact with nitric acid."

"The decrease in inclusion content of 321 steel is a credit to the ingot producers."

"Several British writers have questioned the need for columbium in gas turbine blades and have referred to the successful use of titanium as a hardener in these superalloys."

A U.S. National Production Authority's directive, issued in October, prohibits the use of ferrocolumbium-bearing steels or ferro-tantalum-columbium-bearing steels where any other substitutes can be used. In Mr. Tyrrell's final words : "Columbium must be conserved and usually can be conserved by substituting less strategic alloys without adverse effect on service life."

The Effect of Finishing Processes on the Fatigue Strength of Hardened Steel

A PAPER by L. P. Tarasov and H. J. Grover[1] presents the results of an investigation of the effect of grinding and other finishing processes on the fatigue strength of a steel containing carbon 1·0, silicon 0·25, manganese 0·2, chromium 1·4, and vanadium 0·2 per cent, heat-treated to give Rockwell hardness figures of C45 and C59 (Vickers diamond hardness numbers 460 and 720, respectively).

Hardened steel parts generally have to be ground to size. Incorrect grinding results in excessive heating, which may temper, reharden, stress or crack the surface, with very harmful effects on fatigue resistance. It is not certain to what extent "gentle grinding" may affect the fatigue strength, partly because it is difficult to define exactly what conditions are implied by the term. H. E. Boyer[2], in reporting the results of rotating-bending fatigue tests on hardened steel bars, concluded that the endurance limit of the steel was lower after the most careful grinding than that of polished specimens. In this he is supported by Hankins, Becker and Mills[3], who found that the scratches left by normal polishing, although quite unimportant in ordinary steels, are sufficient to reduce the fatigue limit of hardened steels having a Vickers diamond hardness of 525–580. Elimination of circumferential scratches left by No. 00 emery paper, by final polishing in the longitudinal direction with No. 0000 emery paper, resulted in an increase in fatigue limit of from 6 to 30 per cent. Tarasov was, however, inclined to attribute Boyer's results to undetected overheating effects in the ground surface. He, accordingly, in conjunction with H. J. Grover, carried out some work on reversed bending of flat bars in which it was sought to control the severity of grinding by using appropriate wheels and feeds; wheel size, wheel speed and table speed of the surface grinder were kept constant. Other surfacing operations, which were superimposed on the grinding, were hand-polishing, electrolytic polishing, shot peening and tumbling with Alundum 2-T tumbling abrasive. All bars were ground in the longitudinal direction. The results are shown in Table I.

TABLE I—*Endurance Limit in Reversed Bending of Flat Bars (Tarasov and Grover)*

Rockwell hardness	Additional processing after grinding	Endurance limit, pounds per square inch	
		After gentle grinding	After severe grinding
C59	None	65,000	45,000
	Hand-polishing	59,000	47,000
C45	None	60,000	45,000
	Electrolytic polishing	60,000	—
	Tumbling	—	73,000
	Shot-peening	78,000	83,000

If the direction of the grinding scratches had been perpendicular to the applied stress instead of parallel, the fatigue limits would have been lower. Neither hand polishing nor electrolytic polishing of the ground surface had any beneficial effect : possibly sufficient metal to have the maximum effect was not removed. Shot peening (and to a lesser extent tumbling) had a very beneficial effect, which, curiously, appeared to be more pronounced after severe grinding than after gentle grinding. This does not imply that defects resulting from poor grinding practice can necessarily be corrected in this manner.

The results may be explained in terms of residual surface stress, without the assumption of any real increase in the intrinsic reversed-stress endurance limit of the material. Residual surface tension produced by severe grinding would tend to decrease the range of stress required to cause failure and residual surface compression due to shot peening would tend to increase it.

Rotating beam tests on round bars, ground longitudinally, were also carried out, giving endurance limits higher than those for flat bars in the ratio 2·1 : 1 for material of hardness C59, and 1·8 : 1 for material of hardness C45 ; but, for some reason, they did not prove to be of much use in the evaluation of surfacing processes.

The authors concluded that very careful longitudinal grinding had no adverse effect on fatigue strength, though severe grinding in a longitudinal direction lowered the endurance limit considerably, while shot peening and tumbling both increased the endurance limit, being a corrective for even less careful grinding, inadvertently applied, provided that this was not so severe as to cause rehardening or surface cracking.

REFERENCES

[1] American Society for Testing Materials, Annual Meeting, June, 1950. Preprint No. 18.
[2] *Transactions*, American Society Metals, 1948, vol. 40, page 491.
[3] *Journal*, Iron and Steel Institute, 1936(1), vol. 133, page 399.

The American Society for Metals

AMONG the papers presented at the thirty-second Annual Convention of the American Society for Metals at Chicago this month were several which were of interest to engineers. Various aspects of strain-hardening were described, including the strain-hardening of mild steel at low temperatures. This was measured by means of torsion tests. In the equation of the true stress-strain diagram, $\sigma = K\delta^n$, K the strength coefficient (equal to the stress at a strain of 1) increased continuously without any sudden change down to −188 deg. Cent., while n the strain-hardening exponent decreased with temperature, the form of the curve resembling that found for the transition from ductile to brittle fracture in the notched-bar impact test.

The authors of a paper on the mechanical properties of seamless steel tubes proposed formulæ for the calculation of yield strength, tensile strength and elongation from the chemical composition. These were based on the statistical examination of over 8000 tests obtained from hot-rolled carbon steel tubes made from deoxidised acid Bessemer steel showing a range of composition : carbon, 0·09 to 0·49, manganese 0·30 to 1·60, silicon nil to 0·26, and phosphorus 0·006 to 0·094 per cent. The formulæ, transposed to tons per square inch, were :

Yield strength : 11·7+19·0 C+6·3 Mn+2·3 Si+53 P
Tensile strength : 13·9+44·6 C+9·0 Mn+5·3 Si+82 P
Elongation, per cent : 53·0−43 C−4 Mn−5 Si−105 P

For the average composition, carbon 0·24, manganese 0·6, silicon 0·05 and phosphorus 0·0136 per cent, these formulæ give :

	Calculated	Actual average
Yield strength, tons per square inch	20·87	20·85
Tensile strength, tons per square inch	31·4	31·4
Elongation, per cent	38·7	38·5

The effect of molybdenum (0·25 to 0·30 per cent) and of titanium used as a deoxidiser (0·009 to 0·080 per cent) was also estimated thus :

Yield strength : As above+67 Ti+14 Mo
Tensile strength : As above+80 Ti+25 Mo
Elongation, per cent : As above−78 Ti− 3 Mo

Cleavage fractures in ferrite and in silicon-ferrite, and fracture phenomena under cyclic stress, were described and discussed, whilst various kinds of embrittlement (temper-brittleness, hydrogen embrittlement of stainless steel by steam in heat-treating atmospheres and a type called by the author "rheotropic embrittlement" of steel) received attention in several papers.

Present-day interest in the behaviour of metals at high temperatures and in heat-resisting materials was shown by a number of papers, including two dealing with the formation of oxides on the surface of pure iron and of stainless steel at high temperatures. Titanium-chromium alloys with under 20 per cent of chromium, which show high strength at room temperature, are unsuitable for stresses above about 4 tons per square inch at 540 deg. Cent. With higher chromium content they are brittle. Proposals were made in one paper for obtaining molybdenum coatings on steel by hydrogen reduction of molybdenum pentachloride vapour. A temperature of 900 deg. Cent. is required and improved adhesion was obtained with an intermediate layer of electrodeposited nickel. Four papers referred directly or indirectly to the sigma phase in high-chromium heat-resisting steels. This constituent, the existence of which was first recognised in 1927 by Chevenard, was not identified definitely as based on the intermetallic compound FeCr until 1936. The appearance of free sigma produces embrittlement, but the precipitation of this constituent is sluggish and the phase boundaries not easy to locate. They were accurately determined by Cook and Jones in the iron-chromium alloys of high purity, but both carbon and the small amounts of silicon and manganese usually found in commercial alloys displace the ferrite/ferrite+sigma phase boundary to lower values of chromium. In one paper the conditions of sigma formation in ferritic chromium steels were described, and in others the work was extended to include commercial high-chromium heat-resisting steels with small amounts of added elements, particularly molybdenum, which unfortunately increases the stability of sigma at high temperatures, although the iron-chromium-molybdenum alloys might otherwise be regarded as promising materials for use at temperatures above 800 deg. Cent. The occurrence of the sigma phase, which, even if suppressed by preliminary heat-treatment, may be precipitated in service with consequent embrittling effect, puts rather severe limitations on the range of composition which would be useful for high-temperature duty in gas turbines. One of the papers set out the advantages of nickel-rich nickel-aluminium-molybdenum alloys (e.g., 70 : 8 : 22) for high-temperature applications.

In addition to those already referred to, there were a number of papers devoted to the heat-treatment of steels and to the properties and behaviour of various non-ferrous metals and alloys.

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ACCIDENTS IN MINES

IT is reassuring to the public, as well as to those more intimately concerned, to learn that the figures for accidents in mines reached a record low level in 1949. Nevertheless, in his report for that year just released, Sir Andrew Bryan adds, immediately after this statement, that the total is still much higher than it need be or ought to be with ordinarily good mining practice of to-day. Nevertheless the actual improvement in accident rates for the past twenty years is very impressive; as compared with 1076 killed and 4228 seriously injured in 1929, the corresponding figures for 1949 were 460 and 2180. That is, the total annual number of casualties has been reduced by more than a half in the last two decades. The report is of interest to many, outside the mining industry proper, who use similar machinery or have comparable conditions in one respect or another. For the mines of this country are becoming increasingly mechanised, not only in respect of the actual getting of the coal but in its transport as well. At the end of the year there were 279 diesel-engined locomotives of up to 100 h.p. in use underground. They are used to haul men and minerals on gradients not exceeding a certain limit, and are usually fitted with compressed-air brakes. The continuous braking system, as used on main line railways, is advocated for man-riding trains underground; for the increased factor of safety they provide enables higher speeds to be scheduled. A recent mining disaster has reminded us of the danger arising from heating at belt-conveyor gearheads. There are now available several types of automatic devices, which stop the belt when the slip exceeds a predetermined amount. A few such devices are in use at collieries, and their use should be more widespread. Meanwhile, for safety, frequent patrolling of road conveyors is essential, both during the shift and for some time after the belt has stopped running.

Falls of ground continue to be the greatest single source or direct cause of accidents underground, and a team of inspectors is specially engaged in the development and application of more efficient systems of support. This is a subject of perennial interest to colliery managers, and one under frequent discussion. One reason for this interest is the fact that no single system of support is wholly satisfactory under the widely differing conditions which may exist even between collieries in the same area and even between adjacent pits. Furthermore, supports are themselves now undergoing a phase of rapid development in design and construction, which is in itself of great interest, and the best methods of utilising such novel supports is a subject for trial and discussion. It is satisfactory to note that really substantial improvements in accident figures have resulted whereas rates in this category had remained nearly constant for many years. During the past decade alone the annual rates have declined faster than in any other major category. Accidents arising from falls of ground on roadways have decreased in number even faster than those on faces, probably in consequence of the ever wider use of steel arches. Well over 300,000 tons of steel were used for this purpose during the year—sufficient to line about 1000 miles of roads. Accidents are particularly numerous at and about roadheads, where the roads are constructed and the arches erected. It is of interest to note that a specially shaped and extruded aluminium alloy beam has been developed for the support of the underlip at such places. These alloy bars are as strong as steel joists of twice the weight, and their greater width gives them extra stability.

Dust is becoming a greater problem than ever owing to the increase in machine mining. The chief dangers arising from this source are the immediate ones of fires and explosions, and the less obvious one of pneumokoniosis a disease still causing a loss of man-power of serious concern to the industry. It is inevitable during the extraction of a seam of coal that some degree of convergence between roof and floor must occur, rocks will be fractured, dust will be made and inflammable gases will be released. Although none of these dangers can be eliminated entirely, yet by the exercise of good mining practice and in the light of modern knowledge of ground control, much can be done to reduce their magnitude. For example one investigation made in Kent showed that a reduction in convergence between roof and floor, consequent upon improved roof control led to less crushing of the coal and, therefore, to less dust made and rendered air-borne. It may also be emphasised that an efficient coal-getting machine is one which gets coal with the least consumption of power per ton of coal, because the power wasted will inevitably be dissipated largely in heat, noise, degradation of coal—all highly undesirable in themselves—and in the production of fine dust. The suppression of dust at source is achieved mostly by means of water. In the South Western Division it is done in large measure by infusion of the coal before cutting, i.e., by forcing water under pressure into holes drilled in the face. That method is effective in dealing with one of the most prolific sources of dust and could, it is thought, be applied more extensively if greater perseverance were shown in overcoming initial difficulties elsewhere. Another method is to spray water on to the chain of the cutter and most of the machines now supplied are adapted for that purpose. It can be done even with over-cutting machines, in which the dust problem is worse because the holings and effluent fall into the ventilating current. For it is worth noting that once it is air-borne, wetted fine dust may be just as dangerous as dry dust. Dust raised in haulage can be reduced by careful design to give smooth flow at transfer points, coupled with the use of water sprays or dust extractors. But the report makes it clear that much still remains to be done in the field of dust suppression.

GOODWILL

AT a time of year when we hear on all sides the quotation "On earth peace, goodwill towards men," and when some, at least, of the worries of a restless world are laid aside temporarily, it might be well to stress the value of *industrial* goodwill, take stock of the position at this festive season, and investigate the possibility of developing a virtue which undoubtedly has its commercial value. Overseas visitors to this country were sometimes heard to remark a year or so ago that that important individual "the man in the street" of this country lacked the buoyancy, alertness and confidence that once characterised the Englishman. That state of affairs could no doubt be attributed to the drabness of life, the sameness of our food, the burden of controls, and other vexations, some of which are still with us, and seem likely to remain for long to come. Be that as it may, certainly a cheerful spirit is more conducive to goodwill than anything else. At this time of year, for a few days we all live up to tradition, cast economy to the breezes if not to the winds, lay our cares aside and try to regard all men, even those we find most difficult to understand, with consideration and friendly feeling. Let us then, in that really benevolent state, settle down sometimes—if our children will allow it!—in our favourite armchairs and restfully meditate. For it is only by admitting humbly, but cheerfully, in such meditation that in reality we have little understanding of our own human natures

and far less of other people's that a real spirit of Christmas goodwill can be generated and retained, at least in some measure, for weeks to come.

During the past year there has been much calculated to discourage. The acrimonious atmosphere pervading the world has grown heavier, and party strife has increased in intensity at home. In the industrial sphere some people, as usual, have put their own personal or class interests before those of the community or country, leading to industrial disturbances that are a brake on output and efficiency. Perhaps one of the causes of a lack of genuine goodwill so often noticed in industry is attributable to the increase in the size of factories, which makes personal contact between differing strata, managers and men, research and production, sales and design, much more difficult. In the early days of industrial history the master was himself a craftsman, working with his men, entering into their difficulties, and having an intimate knowledge of their home life. As history flowed on the family spirit for long persisted, and often the apprentice was admitted into his master's home. Thereby there was fostered in the young craftsmen a pride in the works that had undertaken his training, and a desire to further its interests. It must be admitted that those days, if not wholly gone, are now almost beyond recall. But cannot something of their spirit be recaptured? There is nothing like ignorance to engender ill. For instance it occurs when a worker imagines that while he is earning but a living wage, his employer is continually enriching himself, and leading a life of comparative idleness. If only employers would take the trouble to enlighten all their staffs as to the aims and policy of their companies, as to some of the many difficulties that have to be faced and overcome, as to the intensity of competition, and as to the narrow margin between success and failure, they would go a long way towards eliminating ill will. One way of doing so is provided by a system of regular meetings at which questions are encouraged and free discussion welcomed. Again, a suspicion of favouritism in any shape or form is a potent enemy of goodwill, even when it is really quite unjustified. Let a relative of the manager be appointed to or promoted to a responsible position, and though he may obviously be the very best man for the post, the word is certain to fly round that "another case of nepotism is taking place under our very eyes." If, however, the selection had been made by an impartial board, the result must have been the same, but the effects on the community very different. When considering the question of appointments it is well to remember that the introduction of new blood into an organisation, though sometimes necessary, may very adversely influence the *esprit de corps* that is so desirable, unless done with care. For the loss of upward mobility is a serious matter to those affected. Again, a promotion board may prove a big safeguard, particularly if, without unkindness to others, the reason for an importation can be clearly explained, so that its justice is appreciated. But it is, of course, essentially a bad policy to bring in new blood in this way, and yet at the same time raise every conceivable objection to a valued employee bettering his position by going elsewhere! Should he not rather be given a hearty send-off, and an assurance that interest will be taken in his future career? Frustration is a disease that is highly contagious, and rapidly undermines the spirit of goodwill that might have existed but for its baleful influence. At a certain works an experimental machine was urgently required by a given date, and a spirit of enthusiasm was evident in the shop so that the work was satisfactorily completed to time. But then the machine lay unheeded on the shop floor for several weeks! Actually, at the last moment, altered circumstances necessitated the postponement of the experiment for which the machine was being constructed. But all concerned naturally felt frustrated. Was it really too much to expect that on grounds of mere tact the machine should have been removed out of sight?

We have, of course, here only touched the fringe of a subject wide with many implications. But the week that intervenes between Christmas and the New Year is hardly one in which we can be expected to study any subject very deeply. Emotionally, of course, in that period, we do strive to feel goodwill to all men, not forgetting our competitors and the Chancellor of the Exchequer. But, in fact, it is more than likely that, as we meditate in that favourite armchair that we have already mentioned, as we delve, indeed, more and more deeply into the subject, as emotionally and rationally we agree that goodwill should be shown by all men to all men, we shall fall, indisputably, asleep!

Obituary

JOHN ROBERT CAOUL

It is with the deepest regret that we have to record the sudden death on Wednesday, December 20th, of Mr. John Robert Caoul, of 41, Ranulf Road, London, N.W.2, and Aldwych House, in his seventieth year. Mr. Caoul, in spite of ill-health, was active to the last, and, as on all agricultural occasions, he was present at the recent Smithfield Show held at Earls Court. He was born in Riga in 1881 and received his technical education at the Technical High School under Professor Dr. V. L. Maleev, later of Oklahoma Agricultural and Mechanical College, U.S.A. At an early age he decided to take up agricultural engineering and joined the firm of Cyrus McCormick, of Chicago, which later merged with Charles Deering, of Milwaukee, to form the International Harvester Company.

Later on Mr. Caoul joined R. and T. Elworthy, Ltd., of Elizabethgrad, and became in 1909 the general manager for all the Russian and Asiatic countries. In that post he organised a large scheme for making available agricultural machines of all kinds to European Russian farmers transferred to larger farms in Asiatic Russia. That position he continued to occupy until the second year of the 1914–18 war. He was also sent to America to buy steel for the Russian armament programme. Later he investigated the Argentine and South American market and joined J. and J. Drysdale, of Buenos Aires.

With the formation of Agricultural and General Engineers, Ltd., Mr. Caoul was appointed general export manager of the company, and in that capacity he travelled widely in Australia, Africa, South America and Canada, meeting old friends and making new contacts. When that business came to an end, about 1931, he retired. Some time later, in 1933, he acquired a large interest in the Stamford firm of Blackstone and Co., Ltd. He directed the business for three years, and introduced a new design of medium-speed diesel engine. He also built and equipped new shops for the manufacture and servicing of a range of Massey Harris hay-making machinery. In 1936, owing to ill-health, he disposed of his interests to Sir Percy Lister, and the firm then became part of the organisation of R. A. Lister and Co., Ltd., of Dursley, Gloucestershire.

Mr. Caoul's friendship for many years with Mr. Cecil Mackay, of the Sunshine Harvester Company, near Melbourne, Australia, secured for him the London representation of that firm. When wartime production reduced the supply of British-made agricultural machinery, Mr. Caoul clearly saw the advantages of importing such machinery from Australia, and with the Ministry of Agriculture and Fisheries he approached Mr. S. M. Bruce, later Lord Bruce, then the High Commissioner for Australia. By Mr. Caoul's personal efforts many thousands of Sunshine harvesters and combines were made available to the farmers of Britain.

When the Massey Harris Company, of Toronto, decided to establish its own factory in this country, Mr. Caoul's advice was again sought, and he assisted in the design and laying down of the Trafford Park factory, which was managed for many years by the late Mr. G. Jordan, with whom he had worked at Stamford. Mr. Caoul was also consulted with regard to the subsequent decision to manufacture Massey Harris tractors at the Kilmarnock factory.

For many years he retained his office in Aldwych House, and kept in close touch with the leading agricultural firms of the world. His wide and practical knowledge of the corn-lands of the world and their cultivation enabled him to make a valuable contribution to the agricultural engineering profession he had chosen. His administrative and financial experience was fully recognised, and his advice was frequently sought and freely given. His open-hearted and generous personality endeared him alike to staffs and a wide circle of friends in many countries, by whom he will long be affectionately remembered.

Literature

Cellulose Acetate Plastics. By Vivian Stannett. London: Temple Press, Ltd., Bowling Green Lane, E.C.1. Price 30s.

Cellulose acetate plastics differ from other thermoplastic materials in that they are based on one of the commonest organic materials, cellulose. In this work the author gives a brief account of the development of these plastics, including present-day chemical methods involved, but the greater portion of the book is devoted to methods and techniques employed in the production of finished plastics. The manufacture of plastic film and sheet and of moulding powder is described, while modern methods of cutting, shaping and finishing plastic objects are reviewed in great detail. A familiar example of cellulose acetate film is represented by ordinary photographic film. These thin films are produced by a technique which is based on the principle that if a solution of

cellulose acetate is allowed to evaporate on a highly polished surface, a continuous, transparent and self-supporting film is deposited, which can readily be stripped from the polished surface. Machines and plant employed in the production of the film are described and illustrated. In the production of sheet materials having a thickness over 10mils entirely different methods are often used and the finished product is then termed sheet instead of film. This heavier gauge material is produced chiefly by the block process and the book gives a full account of this, particularly as carried out in the U.S.A. The block method consists essentially of forming the cellulose acetate material into slabs of approximately 1in thickness by means of rolling operations, the slabs being termed "hides." The author describes the pressing together—in a hydraulic press—of a number of hides so as to form a thick block, which is then reduced to the required sheet thickness by automatic slicing machines. These methods for producing film and sheet have certain disadvantages. For example, the film casting method is costly and the thickness of sheet that can be fabricated is very limited. Attempts have been made to overcome this difficulty by the so-called multi-layer casting, in which one film is cast on top of another, until the required thickness is built up; but this is a time-consuming process. In the production of thicker sheets the block method is cumbersome and slow, while the dimensions of sheet that can be produced are limited to the size of press, &c., employed. Because of these difficulties in producing films and sheet another method—that of extrusion—has been developed. The extrusion method of sheet production is adequately reviewed and some excellent illustrations of machinery and plant are included. As distinct from the manufacture of film and sheet, a big proportion of cellulose acetate plastics are derived from moulding powder, the finished article being produced either by the extrusion process or by injection moulding. The book contains a comprehensive account of these two methods. The work includes an account of the two basic techniques used in producing moulding powder, which are known as the wet and dry processes, respectively. Since both these methods are tedious and laborious, in recent years efforts have been made to develop more efficient techniques, and the author gives a brief outline of these newer methods. About one-fifth of the total cellulose acetate plastics used is in the form of articles—such as containers—fabricated from rigid sheet. The book describes the chief operations—cutting, shaping, cementing and finishing—involved in fabricating articles from sheet, and this is the section of the book most likely to interest engineers in general. Cutting of relatively thin sheets is done on a guillotine in much the same way as paper is cut and very accurate rectangular shapes can be produced in bulk by this method. For the cutting of odd and curved shapes use is made of a steel cutting die fitted to a power punching press. Thicker material may be cut by band-saw or circular saw. The author describes these various cutting techniques in a practical manner. He also includes some useful details of blanking-out die construction, including open face, steel rule and ejector type dies. The different methods employed for shaping are reviewed and the most widely applied techniques involve the use of male and female moulds of polished metal for normal shapes, while deep drawing is used for deep moulding of intricate shapes. High frequency welding, now often applied in joining together the edges of the material, is described and illustrated. This method of joining overcomes the difficulties encountered when using solvent type cements. One chapter is devoted to the properties of cellulose acetate plastics, in which section is discussed weathering, ageing, mechanical, electrical and optical properties, &c. The work is profusely illustrated with photographs and diagrams, and makes a valuable addition to the existing literature on the subject of plastics.

Gasturbinen mit Gleichdruckverbrennung. By Dipl.-Ing. RUDOLF FRIEDRICH. Verlag und Druck G. Braun, Karlsruhe.

THIS little textbook of some 130 pages, written in German, will have too many English competitors for it to find many purchasers in this country. Indeed, an English translation would not have a great deal to recommend it over similar books already on the book-stalls here. It follows the now well-established plan in which an introductory chapter on the basic thermodynamics of the gas turbine cycle is followed by descriptive chapters on the main components, the compressor, the heaters, the turbine and the heat exchanger, some of which are very summarily discussed. A short chapter on materials follows and the final third of the book is devoted to descriptions of various gas turbines already in existence. Some small mention of aircraft engines is made in this section but the main interest is centred on other applications of the gas turbine.

English readers will be interested in the understandably Continental outlook exhibited in the choice of examples to illustrate the book. There are many references to gas turbines by Brown Boveri, Sulzer and Oerlikon and to the work of Holzwarth, Jendrassik and Lysholm. On the other hand there is no mention of Whittle's work, though there are pictures of a Rolls-Royce "Nene" engine and an Armstrong-Siddeley combustion chamber and a short paragraph on the Metropolitan-Vickers locomotive engine. Developments in the U.S.A. are also only sketchily discussed, the main mention being given to the Elliot-Lysholm marine engine and the two locomotive projects.

The bibliography at the end of the book, which again contains mainly references to Continental publications, will be of value to British readers wishing to make a broad survey of the field of gas turbine literature.

Letters to the Editor

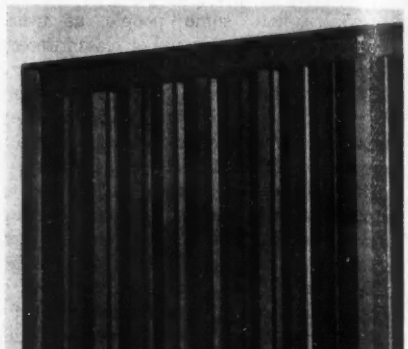
(We do not hold ourselves responsible for the opinions of our correspondents)

PRECIPITATION IN COOLING TOWERS

SIR,—We note with interest the article entitled "Elimination of Precipitation in Cooling Towers," in your issue dated December 15th.

The device described as a "simple form of louvred eliminator" is almost identical in design to the eliminator that has been widely used for at least ten years in commercial mechanically induced draught cooling towers in the United States. The advantages of this type of eliminator have been widely publicised by us in the United Kingdom during the past twelve months. We and the majority of cooling tower designers in the United States, guarantee a definite limit to precipitation from mechanical induced draught cooling towers, and such confidence is largely the result of our experience in full-scale industrial application using the type of eliminator of which a portion is illustrated.

Cooling tower users are, no doubt, interested in experiments which have been carried out with packing adopting a quiescent distribution, which films water over packing without creating conditions encouraging to precipitation. However, as the B.E.A. has presumably



FABRICATED DRIFT ELIMINATOR SECTION

discovered, the first cost, difficulties in inspection and maintenance, loss of efficiency due to algæ formation and silting are serious disadvantages which do not compensate for the advantages gained by eliminating precipitation at its source, i.e., during the progress of the water over the tower.

Well-designed drift eliminators enable the cooling tower designer to cool the water in the most economical and practical manner by providing a cheap splash packing instead of the more costly "egg-crate" type.

HEAD WRIGHTSON PROCESSES, LTD.
London, E.C.1.

SHORT NOTICES

Three-Dimensional Engineering Drawing. By W. E. Walters. Oxford: Pen-in-Hand Publishing Company, Ltd. Price 10s. 6d.—The object of this book is to present a new technique in depicting complicated shapes by direct projection and, although the methods described do not eliminate entirely the necessity for mental visualisation, they do reduce this to a minimum. Furthermore, no other instruments are needed than those in everyday use by the draughtsman. Engineering students who have mastered the principles of orthographic projection can, by careful study of the chapters in this book gain useful knowledge in the technique of pictorial or three-dimensional drawing. The clear and well-drawn illustrations lead the reader by easy stages to practical examples in this type of drawing and the accompanying text clarifies the reason for each successive step.

BOOKS RECEIVED

Are Workers Human? By Gordon Rattray Taylor. London: The Falcon Press, 6–7, Crown Passage, Pall Mall, S.W.1. Price 10s. 6d.

Modern Gas Turbines. By Arthur W. Judge. Second edition. London: Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 32s.

Micro-Wave Measurements. By H. M. Barlow and A. L. Cullen. London: Constable and Co., Ltd., 10, Orange Street, W.C.2. Price 30s.

Great Engines and Their Inventors. By G. S. Ranshaw. London: Burke Publishing Company, Ltd., 180, Fleet Street, E.C.4. Price 10s. 6d.

Traction Engines Worth Modelling. By W. J. Hughes. London: Percival Marshall and Co., Ltd., 23, Great Queen Street, W.C.2. Price 12s. 6d.

The Institution of Mechanical Engineers

AT a meeting of the Institution of Mechanical Engineers, on Friday, December 15, 1950, a paper entitled "Naval Gearing—War Experience and Present Development," by Cdr. (E.) J. H. Joughin, was presented. An abstract of the paper appeared in our last issue. The paper was presented on behalf of Cdr. Joughin by Cdr. Goodwin.

Discussion

Dr. H. E. Merritt said that reduction gear units were peculiar in that their basic dimensions and hence their weight and cost, were directly determined by the instantaneous stresses in a small piece of material. Moreover, the validity of design assumptions rested primarily upon the accuracy with which one machinery operation—the finishing cut on the teeth—was carried out. So many millions of pounds—weight and sterling—depended upon these assumptions that, in spite of the work which the author reviewed, the total effort devoted to fundamental study could only be described as being incredibly small. It had been known at least twenty years ago that a change from medium-carbon to case-hardening steel enabled the weight and bulk of gears to be reduced to perhaps one-eighth, yet no manufacturer in this country had tackled the gear-grinding problem for large reduction gears.

One of the most surprising statements in the paper was that "handwork was sufficient to make the gears run satisfactorily." In view of the very high degree of accuracy shown to be necessary before gears as cut could be relied upon, might there not be some deeper significance in this handwork? It was difficult to believe that handwork could do better than the 0·0005 helix accuracy and 0·0001 undulation, required of machining, and accurate measurement of a pair of "best hand-made gears" might reveal some interesting things. Was it not possible, for example, that scuffing was merely the result of aiming at too perfect a profile and that really drastic profile relief, to concentrate the loading near the pitch line, where rolling velocity was high and sliding velocity was low, might defer scuffing until the surfaces had had time to adjust themselves?

The author described a series of experiments now in hand and the potential value of those experiments was unquestionable. Nevertheless, the author referred at another point to the lack of data on fatigue properties, and one might well ask why more was not done to obtain this information from small specimens. The gear-tooth fatigue bending test machine developed by the Motor Industry Research Association seemed admirably adapted for this purpose. It was simple, cheap, as rapid as a fatigue test machine could be, and used specimens which were actually gear teeth. When creep test machines were in use in hundreds, surely a couple of dozen M.I.R.A. machines would be justified for gear research?

Such a machine could be used to discover the fatigue properties of induction-hardened gear teeth much more quickly and comprehensively than a large experimental gear set could do—whilst recognising that the latter test might have other uses. Induction hardening was, in fact, fundamentally suspect until it could be shown beyond doubt that the quench did not leave a skin stressed in tension.

The great virtue of a case-hardened gear was that its skin had residual compressive stresses; the same effect in unhardened material was obtained by shot-peening, which had demonstrated its value in other directions. Was it not an attractive candidate in future gear research programmes? A few M.I.R.A. machines would enable its gear prospects to be assessed in a matter of weeks.

The use of higher-tensile through-hardened steels, while offering the prospect of notably greater resistance to bending and pitting, might aggravate the scuffing problem. One assumed that scuffing was a problem in high-pressure; high-temperature lubrication and the nature of the gear-tooth material (within the range of gear steels) might not play a large part. The phenomena of lubricated line contact cried out for investigation and though disc machines had their difficulties, they offered a fundamentally sounder line of attack than the use of actual gears, with all the additional variables that they introduced.

A better understanding of the mechanism of scuffing, and a more detailed examination of gear-tooth geometry, might lead to a new approach to gear design. In all the cases and experiments described by the author the choice of pressure and spiral angle remained fairly conventional. Might it not be worth while to speculate more widely on the effect of a much higher spiral angle? It increased the buttress effect of adjacent unloaded sections, it reduced the sliding and increased the rolling velocity, and it increased the relative radius of curvature *pari passu* with the increase in normal tooth reaction.

With regard to tooth helix correction, instead of applying a correction to helices of gears designed and set to run on parallel axes, why not design the gears, produced as truly cylindrical gears, deliberately to run on skew axes with a corresponding difference in helix angles? The effect, unloaded, was to give a degree of crowning substantially parabolic, and its amount could be calculated from the angle of skew.

The outstanding fact which the paper had brought out was the greater appreciation of the significance of measurement as an essential prelude to improved accuracy.

Mr. C. Timms, M.Eng. (National Physical Laboratory), spoke of future developments, particularly in connection with grinding. It must, he thought, be admitted that by grinding one could use materials of higher load-carrying capacity, but there was no evidence available to-day in the marine field to show that accuracy through grinding was any better than, or in some instances, as good as, precision gear hobbing, and he thought that in the case of developments of this kind they ought to be cautious and to approach the matter very carefully; otherwise, they might meet serious trouble. Considering, for example, the indexing mechanism of a grinding machine, produced from a master index plate, the plate was actually produced from a gear hobbing machine and logically it was difficult to see how one could expect any greater accuracy in indexing from a grinding machine as compared with, say, a precision gear hobbing machine. There was, of course, the possibility that one could do a certain amount of correction in the case of grinding, but in regard to gear hobbing, adjacent and single pitch errors could now be controlled to 0·0001in or 0·0002in. The difficulties were more in the nature of suitable measuring equipment to control errors of this nature and it was difficult to see just what improvements in grinding could be expected in the marine gear field as regards accuracy.

Mr. S. Archer, B.Sc. (Lloyd's Register of Shipping), said that mean tooth loading was not often a controlling factor in scuffing and suggested that a more likely criterion would be the product of maximum sliding velocity and depth of undulation, since the phenomenon appeared to arise from local overheating, as suggested in the paper. Might it not be that the all-addendum tooth made greater demands on surface finish than the normal involute type, and would it be correct to say that the latest trends in naval gears were towards a more moderate addendum distribution?

On the use of harder materials in merchant practice, he stated that K values of about 120 and 100, respectively, were at present being adopted for a 3000 s.h.p. double-reduction, single-helical, locked-train gear intended for a Great Lakes steamer. The material of the pinions had a hardness of 350 Brinell and of the wheel rims 200 Brinell. All pinions and wheels would be shaved and Timken tapered roller bearings were to be used for the intermediate gear-shaft. The tooth form was of normal involute type. It seemed fairly certain that if harder materials were to be used to combat pitting and similar defects and permit higher specific loading, accuracy and degree of surface finish must be correspondingly improved.

Cdr. (E.) Weston-Smith (David Brown and Sons, Huddersfield) remarked that many cases of gearing failure had been caused primarily by the bearings, either by wear-down or collapse, allowing the gears to move sufficiently out of line to lose their line contact and thereby their effective face width. He would like to know whether in any of the cases shown in the paper there had been failure of the gears due, not to the design of the gears themselves, but to the way in which they were supported. On the question of the importance which was now attached to interchangeability, he observed that it was only on very rare occasions that one gear of a pair of mating gears failed and did not in its failure damage the other gear with which it was mating. The mating of the worn gear with a new gear was a very doubtful process indeed, although the use of such an apparatus as had been described in the paper, i.e., the portable shaving machine, which had been designed by his firm, might increase the possibility of this being a working proposition and would at any rate eliminate such a tedious and lengthy process as the handwork which had been carried out in "Formidable."

Mr. C. F. Wells (British Thomson-Houston Company, Ltd., Rugby) said that the paper covered a great amount of experience in gear performance, the remedies used to overcome troubles and the conclusions reached relative to their causes. Those conclusions, however, were not always clear, as in the cases of "Speedy" and "Sphinx." Those gears, cut on solid-table machines, were compared with the gears of "Shearwater," which had been cut on a creep machine. On all of these, scuffing had occurred and, because "Shearwater" gears showed faulty alignment, the assumption had been made that such failures could be confined to gears cut on solid-table machines. Such a conclusion was, of course, quite unfounded and was, in fact, contradicted

later in the text by the admission that in "Speedy" and "Sphinx" there had been also evidence of concentration of load at one end. It was appreciated that, in addition to misalignment, concentration of load might result from excessive deflection, torsional or bending, error in helix angles, &c., but these, the causes of some of the troubles experienced by the author, were independent of the type of machine on which the gears were cut. Other failures, however, were due to the inaccuracies of the hobbing machines, both creep and solid-table type. The creep mechanism in the past had reduced the hobber noise by changing the distribution of the "high spots" due to the indexing inaccuracies when they really were inaccuracies. A modern solid-table hobbing machine, operating within the limits of British Standard Grade A under temperature controlled conditions would cut large gears of smooth finish, correct helix angles and an undulation height of ±0·0001in. Such gears were quiet in service and free from vibration. The author gave such an example with the gears of "Creole," where an obviously good hobbed gear had been subjected to shaving, and it was to be regretted that this gear had not been tried out as produced from the hobbing machine without confusing the issue by subsequent shaving. His firm had recently cut a set of marine gears, the final wheel of which was 120in diameter with a face width of 2in by 26in. This gearwheel had a maximum undulation on the tooth flank of ±0·0001in and its frequency noise level was 69 phon, less than 7 per cent of the total engine-room noise. No post-hobbing processes or helix angle corrections had been used and in service the bedding across both helices was 100 per cent, with no sign of scuffing after nine months' service.

He considered that, before the adoption of post-hobbing processes and their enormous expense, it would have been preferable to have manufactured comparative marine hobbed gears by varying techniques and tested them to destruction. For the gears reviewed in the paper, shaving, lapping and grinding were accepted, without a clear reason for their justification other than indifferent machine hobbing practice.

Mr. A. W. Davis, B.Sc. (Fairfield Shipbuilding and Engineering Company), suggested that the greatest possible progress would be achieved in the industry by fostering that union of conceptions which meant that stress must be placed on the similarity of merchant and naval requirements rather than on any essential differences being unduly exaggerated either in scope or in degree.

Mr. A. C. Hutchinson (W. H. Allen, Sons and Co., Bedford) made a slight correction to a statement in the paper. There was, he said, a reference to a test run of a gear of standard Admiralty materials at W. H. Allen, Sons and Co., Ltd. The statement was to the effect that the run had been successful. The run had been successful so far as the pinion was concerned, but he thought that the run must be regarded as having been only incompletely successful in the case of the wheel, which had pitted. The actual lengths of the run had been 600 hours at loads increasing progressively to a maximum value of loading over diameter of 244, this being roughly three times normal. It would be noticed that the failure there had been one of pitting. That particular gear had been a 70/30 corrected addendum design and the pitting had been associated with the pitch line; and he wondered whether it was a fair deduction from the evidence given in the paper that scuffing being a lubrication failure, was more closely associated with the all-addendum tooth, where the sliding values were higher.

The information in the paper was very full, but he suggested that it was not quite complete, and that in the case of much of the data given, a little more detail would make the interpretation a great deal easier. For example, in one of the Tables there were design particulars of three classes of gears; there were five or six which scuffed, three which broke their teeth and four or five of which there was no record of failure. Could that Table be amplified to give the factors which were considered to be the causes of the particular failures, a distinction being drawn between manufacture—i.e., faults in the tooth surfaces and presumably in the fitting and alignment—and the design particulars, which were set out at length in the Table, because in the absence of that clearly stated information, it was rather difficult for the various design factors there put down to be interpreted in true perspective? For example, one might ask why it was that the "Duke of York" had broken its gear teeth, whereas the "J" and "K" class destroyers, with apparently identical load, had not; or, alternatively, why the fast minelayers had not scuffed and the "Hunt" class had done so.

Cdr. (E.) A. J. H. Goodwin made a brief reply and the meeting closed.

Overhauling Wheels and Axles at London Transport Acton Works

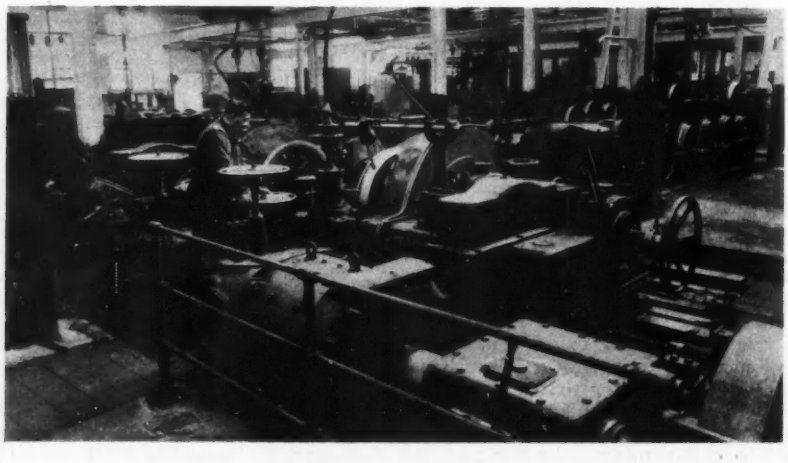
DURING the recent war London Transport's Acton Overhaul Works, besides continuing its normal functions, undertook work for various Government departments and for the Services. No major expansion or revision of lay-out of plant for dealing with the normal function of rolling stock overhaul was possible, so that when such matters came to be considered in 1946 some arrears of expansion had accumulated. Part of the programme of replacement of machine tools and revision of lay-out then planned is now nearing completion.

The most important characteristic of the new lay-out is that the wheels are handled on flow-line principles. There are three main flow lines, one for tyre turning, the second for retyring, and the third for axle stripping and reassembly.

The severity of the Underground service sometimes necessitates reconditioning of the wheel sets after as little as 29,000 miles' running. Approximately 85 per cent of the wheel sets received need correction of the tyre profiles as a result of wear whilst in service; 25 per cent of these sets have tyres which have, as a result of wear and reprofiling on previous occasions, been reduced to a thickness at which they have to be scrapped and replaced. The remaining 15 per cent of the wheel sets require axle and suspension journal grinding, replacement of wheel and gear boss wearing plates, overhaul of roller bearing suspension units, or replacement of defective gears or wheel centres.

On arrival in the wheel area, all axle assemblies are inspected and the axles tested with an ultrasonic flaw detector, which detects any transverse flaws in the axle. Flaws are found infrequently, but it is noted that when they do occur it is under the wheel seat where they could not be detected by any other means, without removing the wheels and gears from the axle. If a flaw is detected on ultrasonic examination, the axle is stripped and placed on a magnetic tester to provide confirmation. If an axle passes the ultrasonic examination the axle assembly is inspected to determine what operations are necessary to make it fit for a further period of service.

If profiling of the tyres will render the wheel set serviceable, it is carried on a transporter (illustrated overleaf) to one of the six wheel lathes which are situated on either side of the transporter track. This is the shortest of the three flow lines, the only process being the restoration by turning of the tyre profile. Our illustration shows a pair of newly turned wheels being taken away on a transporter while an electric hoist is carrying another pair of wheels to the lathe.

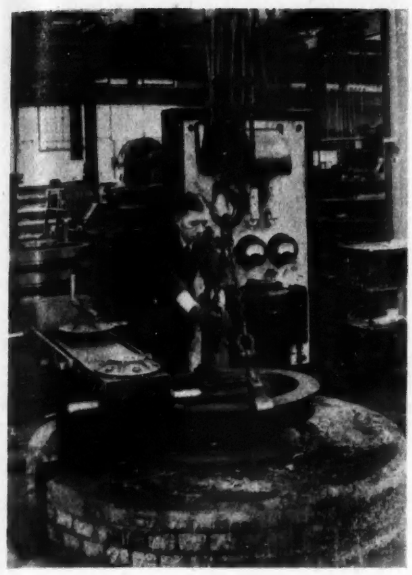


WHEEL TURNING

The wheel sets with tyres which have been worn to scrapping thickness proceed on a flow line across the middle of the shop. They first pass to one of two machines for the removal of tyre fixings; one is designed to drill out the rivets which, on older rolling stock, hold the tyre to the wheel centre; the other is in a form of wheel lathe which cuts away the lip of the tyre allowing the removal, intact, of the retaining ring which is used on the tyres of all the later rolling stock. The wheel sets then move to an area where the tyres are cut through by an oxy-acetylene flame and placed on the tyre-removing machine. This has two saddles fitted with arms arranged to grip the sides of the tyres. The saddles are moved apart by hydraulic rams which force the tyres off the wheels and carry them clear of the ends of the axle. The tyres are then lifted by pneumatic hoists and placed in stillages for transport to the scrap dump.

New tyres are turned on vertical boring

machines to suit the type and size of wheel centre. Next to the tyre-boring machines are the electric induction heaters, illustrated herewith. They have advantages over gas heaters; they enable the temperature to be controlled accurately, and ensure that the tyre



TYRE BEING LOWERED INTO INDUCTION HEATER

is evenly heated throughout its section—an important point as the tyres are of heat-treated alloy steel. The electric heaters are cleaner than gas heaters and have lower energy consumption costs.

The heated tyre is placed on a stand and the

HOIST AND WHEEL TRANSPORTER FOR MECHANICAL HANDLING

axle assembly is lowered on to it. Then the retaining ring is fitted and the lip of the tyre rolled down under hydraulically applied pressure, locking the retaining ring in position. The wheel sets having tyres of the older riveted type are placed on a specially designed machine which drills the rivet holes in the tyres, after which they pass to a second machine for the actual riveting operation. The retyred wheel set then joins the flow line to the wheel lathes (illustrated on page 658) for turning the profiles before being despatched for service. Wheels and gears have to be stripped from the axles of 15 per cent of the wheel sets coming into the wheel area. The stripping and reassembly is done on a flow line round the outside of the shop, which includes appropriate lathes and grinders. The stripping is done on a Duplex hydraulic press of 300 tons capacity, and the components of the axle assembly are then passed to the various machines for attention.

Lathes are provided for turning axle and suspension journals, wheel and gear sets, &c. A rolling attachment provides a pressure of 8400 lb on each of three rolls for cold working of wheel and gear seats, to prevent the formation of fatigue cracks. A Churchill grinder is used for finishing axle and suspension journals and two vertical boring machines carry out boring work on new gears and wheel centres which are then fed to the axle presses for the reassembly of the axles prior to joining the retyring flow line. In one corner of the area three oscillating grinders have been installed for the maintenance of the cutting tools of the wheel lathes. Since it is only possible to turn about seven tyres between regrinds of the lathe tools the new arrangement is an improvement on the previous system by which the tools had to be taken to the toolroom for regrinding. Other sections of the wheel area produce the white-metal axle bearings, which are cast on mandrels in the orthodox way, and recondition the roller bearing boxes with which all the later rolling stock has been fitted. A machine is provided for reamering the white-metal axle bearings and is fitted with a micrometer adjustment for diameter of cut, thus largely reducing the necessity for hand fitting these bearings.

The new lay-out has a planned output of 250 pairs of wheels a week and two-thirds of this total is made up of motored wheels which require work in addition to the simple reprofiling of the tyres. There are, indeed, twenty-one operations which are regularly required to be carried out on wheel sets received in the works, in addition to the reprofiling operation. Of the 17,500 pairs of wheels, only 2030 are motored wheels requiring white-metal suspension bearings. The remainder comprise roller suspension units, as used on more recent stock; the total production of suspension bearings amounts to over 6250 pairs per year, showing an average life of only eight months. It is anticipated that the new wheel area lay-out will be capable of dealing with the wheel work arising from up to 5000 vehicles of modern design.

Twin Screw Cruiser "The Squire"

LAST week we attended demonstration trials of a new twin-screw cruiser named "The Squire," which has recently been completed at the Hampton-on-Thames yard of John I. Thornycroft and Co., Ltd., for Dr. W. B. Mumford, who intends to use the boat for cruising in the waters of Florida, Long Island Sound and the Great Lakes. Before placing his order, Dr. Mumford obtained the assistance of Mr. H. M. Devereux, a naval architect of New York, who, with his special knowledge of the

TWIN SCREW CRUISER "THE SQUIRE"

waters in which the boat will operate, was able to offer much practical advice in preparing the specification.

PARTICULARS AND CONSTRUCTION

The new cruiser has a length of 40ft, a beam of 11ft 6in, a draught of approximately 3ft 6in, and a net registered tonnage of 9·79 The pleasing external appearance of the craft can be seen in the photograph reproduced herewith. The hull is of round bilge form, planked diagonally with a double skin of mahogany, each skin being laid on an opposite diagonal with oiled fabric laid between. The planking is copper, fastened to steamed timbers of seasoned English oak, spaced at 7in centres. The stem, keel, hog, deadwood, knees, deck beams and carlings are all made of English oak; the gunwales and stringers are of Oregon pine and the transom of double-skin mahogany. Pine covered with canvas forms the forward deck, which is finished with a teak covering board, while the side and aft decks are planked with teak, laid fore and aft, with caulked seams. Mahogany is used for the superstructure and the internal joinery work; the internal bulkheads, however, are of mahogany faced waterproof plywood. Pine flooring is fitted throughout and there are sufficient hatches to give adequate access to the bilges. Oregon pine engine bearers are fitted and they are carried well fore and aft, stiffened with knees and securely fastened to the hull. All the timbers used in construction were treated with "Cuprinol," and all the fastenings are of non-ferrous metal.

ACCOMMODATION

In the comfortably furnished deck saloon, which forms the main living quarters, the large beam of the vessel is used to full advantage. The fittings include a settee, which extends to form a double bed, a drop-leaf table, easy chairs,

and venetian blinds are fitted at the windows to provide privacy combined with ventilation when moored alongside a quay. Portable sections are arranged in the roof of the saloon through which the engines can be lifted for overhaul. Going forward, a stairway leads down to a small lobby with a fully equipped galley on the starboard side and a toilet and linen cupboard to port. Another door backed by a full-length mirror leads to the forward cabin which has a sleeping berth on each side with drawers and open stowage underneath. Overhead is an escape hatch which is reached by a ladder on the bulkhead; a hatch in the upper part of the forward bulkhead gives access to the chain locker.

A short stairway at the aft end of the deck saloon leads to the aft cabin, which has a dressing table and drawers fitted against the aft bulkhead and a berth on each side. Forward on the port side a sliding door gives access to a toilet provided with a shower for which an electric pump supplies the water. The aft peak houses the steering gear and also two 30-gallon fresh water tanks. Returning to the saloon, double swing doors on the starboard side aft give on to a stairway by which the roomy aft deck is reached. The outside steering position is located at the aft end of the deck saloon superstructure and protected by a large vee windscreen.

ENGINE-ROOM

The cruiser is propelled by a pair of Thornycroft "R.T.R-4" four-cylinder diesel engines with Ricardo heads. The engines are carried on resilient mountings and installed under the deck saloon floor in which hatches give access to the engine-room and allow for easy removal of the engines. Each unit develops 40 b.h.p. at 2100 r.p.m., and drives a Thornycroft three-bladed, manganese bronze propeller through an oil-operated reverse gear and a 2 to 1 reduction gear. A closed-circuit fresh-water system is used for cooling purposes and the circulating water is cooled by means of external heat exchangers which consist of headers and a bank of tubes fitted close to the keel. A single lever control system for each engine is fitted at the steering positions in the saloon and on deck. This enables the fuel control and reverse gear of both engines to be operated simultaneously by one hand if necessary. A wet exhaust system is fitted and a special pump provided for water injection purposes. A 12V lighting system is installed, the current being supplied by two batteries of 116Ah capacity which are charged by dynamos driven by each main engine. As the boat will be cruising in American waters the machinery and electrical installations comply with the requirements of the Department of United States Coastguards Motor Boat Regulations.

The forward end of the engine space is occupied by two fuel tanks each of 110 gallons capacity and, at the after end, outboard of each engine, is a 40-gallon fresh-water tank. The remainder of the total fresh-water capacity of 140 gallons is carried in two tanks which are located in the wings of the aft peak. Fireproofing and soundproofing of the engine-room has been carried out by partly lining the space with "Acousti-pads." These consist of a sandwich of sound-absorbing material bonded between metal sheets, and have been applied to the forward and aft bulkheads and to the underside of the floor of the deck saloon. On trials the designed speed of 9 knots was attained and during the demonstration the boat proved to be easily manœuvred, a turning circle with a diameter of approximately two boat lengths being observed, with both engines full ahead. The fuel capacity gives the boat a cruising range of 500 miles. "The Squire" will be shipped out to Nassau by steamer; she will then proceed under her own power to Miami, and continue northwards along the Florida coast, making a number of calls on the way.

SEAWEED RESEARCH LABORATORY.—A new laboratory at the Institute of Seaweed Research, Inveresk, was opened on December 22nd by Mr. Hector McNeil, Secretary of State for Scotland.

The Sleeve-Valve Diesel Engine

THE nineteenth Andrew Laing Lecture, entitled "The Sleeve-Valve Diesel Engine," was given by Sir Harry Ricardo, B.A., F.R.S., before the North-East Coast Institution of Engineers and Shipbuilders on December 4th, and a summary is given below.

The author gives as his reason for selecting this subject that years of experience with the poppet-valve engine have emphasised the advantages of the sleeve-valve version for prolonged hard work. He briefly reviews the early beginnings of the sleeve-valve engine and the improvements in the poppet valve. He gives his early idea of the advantages and disadvantages of the single sleeve valve and his decision to start investigations in 1919 to prove their correctness. The building is mentioned of the first experimental unit, which achieved a fuel consumption of 0·45 lb per b.h.p. per hour, and various points connected with the running of the engine are discussed, such as piston clearances, width of rings, lubricating oil consumption, which was originally rather high, but was eventually reduced to 1 per cent of the fuel. A major surprise was the high mechanical efficiency and the cool running of the piston, which led to lengthy investigations into heat transfer problems. These tests, he states, revealed that a moving oil film is an effective convector of heat and that a moving sleeve is very effective in transferring heat over the length of the cylinder, thus reducing thermal stresses. The high mechanical efficiency is attributed to the full fluid lubrication maintained by the relative motion between piston and liner and may also account for the absence of wear.

The author states his belief that the stable rotational swirl set up by the tangential entry of the air ideal for compression ignition and led to the decision to build a diesel engine embodying the principle of the sleeve valve. Trials indicated that the injector used was sensitive to air swirl intensity and that it was necessary to control the rate of air swirl. A small anemometer installed in the combustion chamber gave comparative measurements of air rotational speed when the engine was motored, and the swirl ratio, that is, the ratio of anemometer speed to crankshaft speed, was found to be constant over the speed range for any given setting of the baffles placed outside the air inlet ports. The author mentions that a coarse low-pressure jet gave the best results and, placed in the most favourable position in the chamber, combined with optimum air swirl, gave a fuel consumption of 0·34 lb per b.h.p. per hour, a figure which, although achieved twenty-five years ago, has not been reached by any unsupercharged poppet-valve engine.

The first marketable diesel engine built in 1927 is described and the mistakes explained, and it is noted that many engines showed negligible signs of wear after running 60,000 hours. Sleeve-valve petrol aero-engine developments are traced up to the Rolls-Royce "Eagle" engine of 3500 b.h.p., and 200,000,000 horse-power is given as the total constructed by 1945. Early experiments, it is stated, indicated that the future of the high-speed diesel engine lay in the propulsion of heavy road vehicles, but the failure of the double sleeve-valve engine condemned the single sleeve model for road transport work. Under such circumstances it was decided to apply the lessons learned to the poppet-valve engine, and after much effort and attention to detail a consumption of 0·39 lb per b.h.p. per hour was attained. The production of poppet valve engines achieved such success that the sleeve-valve diesel was abandoned.

Finally the author restates the virtues of the sleeve valve, maintaining that the combustion conditions are ideal, the breathing capacity and mechanical efficiency are better than the four-valve poppet-valve engine, the mechanism requires no adjustments, the sleeve has ten times the life of a stationary liner, and that ring sticking is unknown. The true role of the sleeve-valve diesel, he feels, is in the large engine working for long hours at high load factors.

Electricity Load Shedding

THE Minister of Labour has accepted a recent report on load shedding submitted by the Electricity Sub-Committee of the National Joint Advisory Council. According to the report, load shedding during September, October and November of this year was considerably heavier and more extensive than in the corresponding months of 1949. Power cuts during these months resulted in certain loss of production, damage to material and in some cases danger to life and limb in industry. The sub-committee finds that heavy load shedding in recent months was the result of a combination of factors. First, there has been a heavy increase in the consumption of electricity, which is reflected in higher demand at peak periods. The average daily peak demand during the three months ended November last was some 1200MW greater than during the corresponding period last year. Second, weather during September, October and November was considerably colder than during the same period in 1949. Third, the percentage of the British Electricity Authority's total generating capacity which was out of service for various reasons during these months was considerably higher than had been anticipated, and the main cause of this was the increased incidence of breakdown of plant. The sub-committee feels keenly that industry is still bearing the main burden of load spreading and if further sacrifices are to be called for, it is essential that there should be a much more drastic approach to the commercial and the domestic consumer in order to secure greater economy in the use of electricity at peak periods. The sub-committee believe that the general public is not yet alive to the serious threat to national production, to employment and earnings and even to the physical safety of large numbers of workers, which is involved in continuing heavy load shedding, and they recommend that there should be a forceful and aggressive publicity campaign utilising the Press, films and broadcasting to bring home these facts. Although further load spreading by industry would not completely eliminate power cuts, the sub-committee believes that increased efforts in this direction would reduce the amount of shedding, and recommends that Regional Boards for Industry should appeal to industry and commerce in their areas to put into operation the load-spreading measures which were in force last winter wherever this is considered practicable by the firms concerned, with the object of securing a reduction in the peak load approximating as near as possible to 20 per cent. The greatest possible use should be made of auxiliary plant. Further, the sub-committee is not prepared to recommend general resumption of Saturday morning work with a compensatory half-day off during the week as a measure to spread the load in industry; it supports the proposals for warning industrial consumers of impending power cuts by means of short-wave radio transmissions by the Electricity Authorities, and for broadcasting more detailed economy warnings by the B.B.C. The sub-committee also recommends that consideration should be given to extending the period of prohibition of display lighting to an hour later than 6 p.m., so that, if industry chooses to work after that time, there would then be a greater assurance of adequate power supplies in the evening. As the problem of peak hour load shedding is now clearly seen to be long-term, the sub-committee recommends that the possibility of the B.E.A. discriminating to a greater extent than is done at present between different types of consumer when cuts have to be imposed should be looked at afresh.

DOCK LABOUR BOARD.—The Minister of Labour states that, after consultation with the National Joint Council for the Port Transport Industry, he has reappointed Sir Thomas Gardiner as vice-chairman of the National Dock Labour Board until March 31, 1951.

WORLD CRUDE OIL PRODUCTION.—According to the American Petroleum Institute, production of crude petroleum reached a record total of 3,786,000,000 barrels in 1950, which was 360,000,000 barrels over the previous record production achieved in 1948.

The Future of Railways*

By F. Q. DEN HOLLANDER†

Task of the Railways

As the conviction is growing in the mind of the general public that regulation and co-ordination of transport under Government control cannot be dispensed with, we may start, in trying to construct a future picture of the railways, from the supposition that any unwarranted expansion of any branch of transport will not be allowed. For each transport branch, the place must be determined on the basis of its expected technical and economic development in conformity with the traffic forecast.

For railway undertakings this determination of sphere is most important. They want stability inasmuch as they have to organise themselves for long periods, with the result that they are far more vulnerable than road and air transport, which like water transport, are not burdened with the cost of their way, safety appliances and—as far as road and air are concerned—stations.

Before considering the task of the railways concretely, it is necessary to distinguish their position clearly.

Every society—looked upon as one nation—requires a national transport apparatus for social, economic, cultural and state reasons, stringing together the whole territory of the nation in its main arteries, having operating and transport obligations, and fulfilling these obligations within limits acceptable to the population.

The railways with their considerable transport capacity, their great speed and consequent possible short carrying-time, their high regularity and safety, will be able under all circumstances, to satisfy these demands in a manner of which no other means of transport is capable.

In this national position, however, their task will all the same be restricted, since outside the main lines all other traffic arteries have to be subjected to other standards—in the first place economic standards.

Financial Structure of the Railway

In order to be able to perform its function in the public interest and to continue to do so, it is essential for the national transport apparatus to lead a healthy life. This implies that it will be possible for the railways to be the national means of transport, only if they can perform their task in a technically efficient and economically paying way.

It is intolerable that undertakings, including public ones, should perform services with constant losses. This theory is proved by the *reductio ad absurdum*. If all should work at a loss, how could this continue? Once losses start, there follows the covering wholly or partly of such losses, from resources which should be employed for depreciation, with the result that no renewals or only partial ones are made and, consequently, the undertaking becomes more and more out of date.

The undertaking that is to be a "national" one indeed, must be able to keep rejuvenating permanently by renewals and modernisations. This is possible only if from year to year the amount for depreciation is fixed at the exact level and provided this amount will really become available for renewals.

Besides this, it must be accepted as axiomatic that the capital by which the undertaking works, shall receive the normal return, in other words, that interest and dividends must be earned.

In the case of external influences which cannot be controlled by the Netherlands Railways and which raise costs (e.g., rises in prices of fuel, energy and metals, rises of wages, falls in the value of the currency), these influences must be met by alterations in rates and charges. A special circumstance in this respect is that railway undertakings in their tariff policies are restricted, inasmuch as the standard tariffs have a national validity. On a costly line with but little traffic, the same price is charged as on a line with much traffic. Besides, the standard tariffs have to be published and are subject to the approval of the Government, a fact which makes them but little flexible. On the other hand, in all countries differentiations of tariff are applied, and often numerous tariff reductions are granted. Although, by reason of the above factors, the direct connection between costs and tariffs with the railways is relatively loose, the tariffs should be so high that revenues as a whole cover total expenses, while alterations in the tariffs must not interfere with the retention of their share in the total traffic volume.

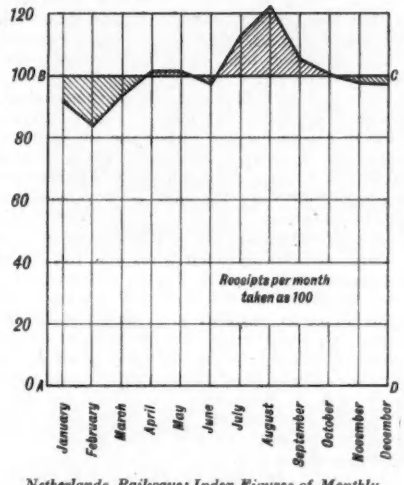
If therefore we start with the revenues from traffic, and determine the amounts necessary for the maintenance of the undertaking on a modern basis, for taxes, and for return on capital we get the amount which can be used for operating purposes:—

Revenue—(depreciation + taxes + interest + dividend) = operating expenses.

Revenue

The revenue and so, indirectly, the traffic volume, requires constant attention, expressing itself in tariffs capable of being adapted—in a commercial sense—continually.

In endeavouring to retain the share in the traffic, some important stabilising factors are of influence. In the Netherlands there are several of these factors, which are of significance.



Netherlands Railways: Index Figures of Monthly Traffic Receipts

The railway system is relatively small compared with the road system, but it serves the principal districts of the country, connecting them one with the other. The railway undertaking has surrounded itself, in a subsidiary relation, with some nineteen motor-bus undertakings, providing passenger transport on many regional feeder lines in connection with the railways. For goods transport, it has at its disposal a national road transport undertaking, which handles collection and delivery regionally and locally and which, further, provides for the regular senders by railway, by means of trunk services, that transport for which the railway itself is not suited.

In 1949 the railways in combination with their motor-bus undertakings, carried 279,000,000 passengers, of whom 113,000,000 were by motor-buses.

The goods transport undertaking, with about 800 offices at 600 stations of the railway undertaking, carried 1,300,000 tons of goods.

A water transport undertaking, which is in the hands of the railways, performed supplementary transport over the most important waterways.

In equipping itself, the railway undertaking is guided by the volume of traffic, both passenger and goods, to be expected on the basis of the transport analysis. It strives after a maximum of efficiency and facilities with the result that it offers services which are not inferior to or more expensive than those offered by the other transport branches.

In this connection, the following should be observed with regard to the network.

As in the case with the networks of all railway undertakings, the Netherlands Railways network is of historical growth. This growth was not harmonious; the lines differed in importance. To the important main lines were added lines of more or less important regional significance. This is clearly illustrated by the division of the passenger revenues. If the lines of the system are considered according to the measure of their revenues, it appears that 43 per cent of the revenue is yielded by only 10 per cent of the length of the network. On 70 per cent of the system, 95 per cent of the revenues is obtained; the remaining 30 per cent yield only 5 per cent.

If the revenue should no longer cover expenses and the undertaking consequently should become deficient, and if all the technical and commercial means which might maintain the financial balance are exhausted, it is necessary for the lines of those 30 per cent to be further examined. They are there for historical or traffic-political reasons or perhaps for reasons of an economic-political character, constructed at a time when other means of communication were less common. They must, however, never become the cause of the decay of the whole system; the traffic will, under such circumstances, have to be transferred to a means of transport which is able to carry it in a way which covers expenses.

Operating Expenses

An exact and constant analysis of expenses, split up as far as possible according to passengers and goods, and also to the clearly distinguishable lines and groups of lines, is absolutely necessary. This will prove that on a number of lines of the system the railways have in fact lost the struggle. They have fallen into the dangerous downward spiral; revenue has decreased because of diversions to other means of transport, the results of the system as a whole have no longer admitted of renewals which might have prevented the wearing away, expenses have increased on account of the obsolete stock and obsolete permanent way, service and comfort have decreased, with the result that an ever increasing number of passengers on these lines have turned to the modern motor-bus. This caused the results on these lines to decline further, resulting in the picture we know but too well at present—the railway sometimes very much out of date, and by the side of it the modern super highway with motor-bus, motor-lorry and private transport rushing along at high speeds.

The railway authorities will have to recognise and accept this position. They will have to watch their network permanently, either the lines separately or in groups. The traffic value has to be calculated not only for the present time but also for the future. Opposed to this must be placed the investments and the operating expenses for the different modes of transport known to science at the present day—steam, electric and diesel-electric traction on the one hand, and motor-bus and motor-lorry on the other. If there are lines which prove to be worked at heavy losses—which lines or groups of lines, being unremunerative, have, as a matter of fact, become superfluous—only two measures are left which can be applied to them:—

(a) Operation is continued without renewals, and as soon as the direct costs are no longer covered, operation is discontinued for passenger and goods traffic, or for passenger traffic only.

(b) Operation is discontinued immediately, either with or without maintaining the line for goods traffic.

In case the discontinuance of the service in any form whatever is deemed unacceptable by government in the public interest, the operation of the line will have to be continued at the account of the government, which will have to pay the deficit as soon as the operating accounts of the whole system show a loss.

If, in this sense, railway systems are examined critically, many kilometres will in fact come up for closure, in whole or part.

The question arises immediately whether the facilities are to be replaced and if so by whom. In many cases the replacing means of transport will already be available since it is this very

*Institute of Transport, November 20, 1950. Abstract.
†President, Netherlands Railways.

same means of transport which has occasioned the decline of the railway. In order to guarantee to the district concerned that, after the suspension of the railway, the necessary services are afforded, two measures have to be taken :—

(a) Operation and transportation are made obligatory for the replacing service.

(b) In the concession of the motor-bus undertaking must be included such routes as will secure the effective linking up of the network of the motor-bus undertaking with the railway stations concerned.

As a replacement service the regional undertaking is the most suitable, since this can be adjusted wholly to the needs of the district. The district can be represented in the undertaking and make its influence felt in it. The regional undertaking can provide for the district a complete and fully organised transportation service.

Moreover, the regional motor-bus undertaking must operate its services in such a way that the district feels itself as a part of the national transport system. In addition to good connections with rail transport a complete system of through tariffs is also desirable to that end.

It must be admitted that thus far so drastic a curtailment of the railway system as just mentioned, has but sparingly been achieved, and on many systems may not be attempted to such length.

The Netherlands Railways, however, have been intensively occupied with this matter since 1938. Up to October, 1950, 407km of their system—which is 13·5 per cent of the system in 1938—were closed for passenger traffic, and on some lines for goods traffic also. During the same period they closed a number of small stations on the lines still operated, because the cost involved in stopping trains and attending to the traffic, exceeded the revenue and—this is very important—the traffic of the villages concerned could be performed better by the motor-bus services already existing. By this a transfer, both economically necessary and technically justified, to the most suitable means of transport was effected at the same time (see Table I).

TABLE I—*Netherlands Railways*

	1938	1949	1950 October 1st
Kilometres of lines operated at close of year	3,335	3,208	3,216
Kilometres of passenger lines operated at close of year	2,962	2,708	2,597
Number of passenger stations operated at close of year	416	374	373

It is also due to this process that the Netherlands Railways now have a very great density of passenger traffic (Table II).

TABLE II—*Density of Passenger Traffic*, 1949

	Passenger-kilometres 000,000s	Sections	Passenger kilometres per section kilometre 000s
Netherlands	6,478	3,208	2,019
France	29,441	41,305	713
Belgium	7,116	5,026	1,416
Switzerland (S.B.B.)	5,864	2,975	1,971
Italy	20,576	16,250	1,266

Nevertheless, the Netherlands Railways system has as yet not attained stability as a paying concern ; more passenger traffic will have to be transferred to the road in the near future. On the other hand, the construction of very promising new railways is conceivable. These include a direct line from the Hague to Amsterdam, 60km long, which will doubtless cause passenger traffic to pass from road to rail and which will greatly contribute to the development of the traffic.

If, therefore, on the one hand, this is continued, it will be necessary on the other to watch permanently the different elements of operating expenses and to try and restrict these expenses by renewing and modernising.

The financial course of business with the Netherlands Railways for the year 1949 may serve as an example :—

	Guilders 000,000s
(1) Operating expenses :	
Personnel	116
Motive power	36
Other	62
	—214
(2) Depreciation :	
Tracks, yards and bridges	28
Rolling stock and electrification	33
Buildings and investments	4
	— 65
(3) Interest and profit...	7
	286
(4) Revenue	286

These figures show the special significance of some items : personnel with 40 per cent ; motive power with 12½ per cent, and depreciation with 22½ per cent of the total expenses.

It is useful to consider these items further : in doing so it is first necessary to determine further the form in which operation has to take place.

First and foremost it must be held that even though a system has been reduced to the lines which as a whole make paying operation possible, the rule of conduct should invariably be that the service must be better than that afforded by road, air and water transport, special attention being paid to the feeder services on the road.

This implies that speed plays an important part, not primarily as regards the maximum speed of the trains but rather the total travelling time from door to door. From this it follows that very frequent train services are necessary, for only by that is it possible to offer a maximum of good connections, not only at the intermediate stations but also at the starting stations between train and the feeder transport. For goods the same is true and it must further be held that the transport of goods must be handled preferably during the night. Not only can goods transport be carried out more quickly during the slack hours of the passenger traffic but the number of tracks and yards can be kept smaller. Both are very expensive investments and costly in maintenance and consequently must be restricted as much as possible.

An important question arising with regard to operation is the question of the size of the undertaking. The total of the traffic which according to the traffic forecast may be expected during a year is not distributed over the twelve months evenly. The season-pattern of the Netherlands Railways, for instance, is shown in Fig. 1.

If it is considered to be the task of the undertaking to carry also peak traffic with normal comfort and service, this will mean that the undertaking has to equip itself (both with regard to personnel and stock) for a transport volume equal to the rectangle with the year as the base and the highest peak as the vertical. This causes the rolling stock to be utilised much less than capacity outside the peak periods, and this in its turn is the cause of considerable losses. Not infrequently endeavour is made to cover these losses due to an excess of stock and an excess of yards and tracks, by attracting extra traffic at special rates. Generally speaking these special rates have a price-spoiling effect with the consequent result that a relatively great percentage travels at reduced rates.

The reverse ought to apply : practically all passengers must travel at normal rates, which in that case can be relatively low. Railways subsist on such passengers as make use of the railway services daily and not on such as apply to them a few times a year to be transported. It is not intended to deal here with the problem of the most favourable size of the undertaking but it will be clear that the undertaking had better adjust itself to a traffic volume as indicated in Fig. 1 by the rectangle *A*, *B*, *C* and *D*. The peaks have to be met by the restriction of maintenance during these periods, by filling up all available carrying space with the goodwill of passengers and senders. Where this goodwill does not exist it is far cheaper to let them turn to the other means of transport than to try and retain them by additional investment.

During 1939 the Netherlands Railways carried 95,500,000 passengers with 151,300 seats ; during 1949 they carried 166,600,000 passengers with 96,850 seats. This ratio becomes more favourable as the circulation of rolling stock is accelerated.

Personnel Expenses

Indirectly-productive personnel is almost everywhere still too large in number. As to this point it can be said that administratively a simplification is possible. A very great number of this personnel enter the railway service straight from the school benches and remain with the railway for the whole of their lives. So they have no experience of the methods of operation in other enterprises, with the result that their own methods are maintained unaltered from year to year. New methods are but sparingly, and then only with the greatest difficulty, achieved. Without adapting or doing away with old working methods new ones are introduced and this has resulted in an ever increasing number of those employed in the administration (Table III).

TABLE III—*Netherlands Railways—Personnel*

	Total	Headquarters
January, 1940 ...	32,722 (100)	1,991 (100)
January, 1946 ...	41,220 (126)	3,725 (187)

For such increases of administrative personnel no undertaking can afford the money ; they must be swept away without delay. No more can the indirectly-productive personnel be allowed to do work that is not essentially railway work. This kind of work is not of a permanent character. Much of it can be better planned by specialised architectural offices and executed by contractors and factories. The great advantage of this is that the railways in this way share in the experience gathered in other enterprises.

Besides, it is psychologically wrong to insist on doing everything oneself ; for trade and industry it is very interesting to be allowed to do railway work, and at the same time it acts as a stimulus to them to use, for their personnel and goods, the railway which is such an important client. It is this element of reciprocity, however, which plays an important part. Industry may do for the railways the same as it does for road transport and aviation. Instead of keeping initiative and the lead altogether to themselves, the railways must allow industry to have a share in them. Industry can plan complete constructions, build and try prototypes, all of which can be produced in large series afterwards.

Especially in the U.S.A. is this development perceptible, doubtless under the influence of the automobile industry. Elsewhere, however, it is the railways which still keep the conception and even the production too much in their own hands. It is worth noting that in doing so they assume a combination of responsibilities. Products may be seen, proceeding not from one hand but planned and made by many. In this way the so necessary undivided responsibility is lost.

This applies not only to the construction of new objects but also to the execution of big repairs. A great advantage of this is that industry in doing extensive repairs also notices the defects and deficiencies of its own products and can correct them in new constructions.

Conclusion

There is a good future for those railways which know how to restrict themselves to their proper functions and consequently are willing to transfer to others what can be done better by them. That future will not only be good, but even better if the railways will keep themselves young, strong and adaptable.

In that case they will actually be what they now wish to be : a great contribution to the prosperity of their country.

The Promotion of Electricity Production in Europe

A STATEMENT issued by the Economic Commission for Europe (E.C.E.) last week says that a major step was taken recently by Government, legal and technical experts in Geneva towards the elimination of legal obstacles to the development of hydro-electric resources on European frontier rivers and lakes and towards simplifying legal and economic conditions governing the export and import of electric power. These experts, at a meeting called by the Electric Power Committee of the United Nations Economic Commission for Europe, undertook a systematic effort to replace by means of two conventions and model agreement clauses the welter of varying national laws and international agreements, which now frequently hamper electric energy trade and development. They proposed the preparation of a model agreement to facilitate the development of hydro-electric resources of rivers and lakes of interest to two or more countries. The model international agreement would include fiscal, customs and payments guarantees whose present absence discourages development efforts.

INTERNATIONAL DEVELOPMENT COMPANIES

The experts in the E.C.E. legal group also envisaged the eventual creation of companies not under national but under international law, which would be responsible for the construction and exploitation of such hydro-electric resources—a new legal conception in electric energy development. The E.C.E. secretariat was asked to prepare a study on this subject, using such examples as the airport of Bâle-Mulhouse and the treaty between the United States and Canada on the St. Lawrence waterway.

In an effort to promote "guaranteed exchanges" of electric energy between any given two countries (annual contracts providing for energy exports by one country during a certain season and imports during another season), the creation of new legislation was considered. The secretariat was requested to submit a draft text of a convention providing a uniform law and instituting a simplified procedure for such exchanges. One object sought by this convention is to have these exchanges take place on the basis of a simple authorisation of the ministry in charge of electricity. In most western European countries the authorisation of several ministries, as many as ten in one case, is now required for such exchanges.

The secretariat was also requested to prepare a draft convention covering occasional exports of electricity. The idea would be that each country grant to its electricity companies the right to export without authorisation certain quotas of electricity. This would facilitate electricity exports by eliminating the necessity of obtaining individual authorisations, for example, at times when an abundance of rainfall would permit the generation of more electricity than could be used within the country concerned.

After its comparative study of national legislation covering exports and imports of electric energy, the group of experts decided that legislation of the present type covering the export of energy for cash should be maintained. It was believed, however, that countries could effect simplifications suggested by the comparison of the legislation of the different countries.

The secretariat expects to be able to have the texts for the model agreement and conventions ready by February, when the group of experts hopes to place them in final form for approval by the Electric Power Committee.

American Engineering News

A Self-Centring Roller

Applying the principles underlying the crowned belt pulley to the rollers of steel mill run-out tables and those used on continuous processing lines for wide strip materials, E. T. Lorig, chief of the senior engineering staff of the Carnegie-Illinois Steel Corporation, of Pittsburgh, has developed an interesting self-centring roller, which is already in practical use on pickling and galvanising lines in mills of the United States Steel Corporation. Fundamentally, the Lorig self-centring roller is a slightly crowned roller cut transversely at the centre, the two halves being fixed to rotate as a unit. The working surfaces of the two parts are approximately horizontal (Fig. 1) while the axes are at an angle. In this way the planes or lines of force in both halves "twist" evenly towards the centre in the direction of movement, conferring a self-centring action on any materials passing over the rolls. Side guides are, consequently, not necessary to keep materials on the conveyor. Experiment has already shown that a crown deviation of as little as 0·001in from the horizontal is sufficient in a split roller to create the planar action which is the major force acting in the self-centring roller.

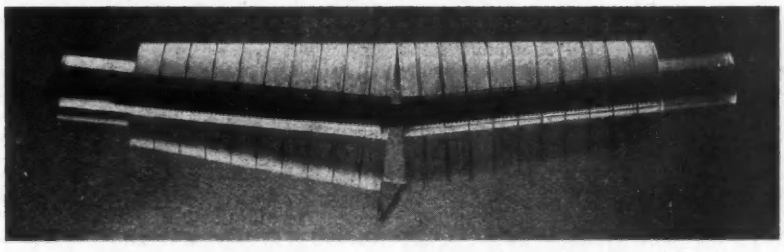


FIG. 1—PLASTIC MODEL OF A SELF-CENTRING ROLLER

The rollers have been tested in a number of applications, such as run-out tables (Fig. 2), feed and guide rollers for electrolytic tinning, galvanising and pickling lines, gravity conveyors, belt transmissions and other conveyors used in the steel industry. In most of its practical applications in industry the self-centring roller is anticipated to eliminate the need for table guides and side rails on conveying tables and lines, thus helping to eliminate edge and corner damage to sheets, strip and plate materials. Furthermore, use of the new kind of roller will permit the width of run-out tables and conveyors to be reduced to a bare minimum without incurring either damage to the material being conveyed or risk to the operators attending the machinery. Belt drives employing the rollers have proved practical and safe, even when incorporating an overhung take-off.

The self-centring rollers are now being manufactured at the Johnstown Works of the Carnegie-Illinois Steel Corporation. Experiments are proceeding at the Isabella blast furnaces of the corporation to develop a stainless steel conveyor belt, operating on self-centring rollers, to handle hot sintered ferro-manganese flue dust. A pickling line equipped with the rollers is in operation at the McDonald Works of the company and another installation is operating on a galvanising line at the mill of the Tennessee Coal, Iron and Railroad Company at Fairfield, Alabama.

Expansion of Federal Power Programmes

On the basis of present-day construction costs, the agencies of the U.S. Federal Government—the Bureau of Reclamation, the U.S. Army Corps of Engineers and the Tennessee Valley Authority—have received authorisation for power expansion programmes valued at 10,625 million dollars. If the various plans are accomplished, there will be a threefold increase in electricity supply or an installation of 18,000MW during the next nine years. Thus, by 1960 Federal power stations would generate approximately 100,000 million kilowatt-hours of hydro-electric power a year, compared with 40,000 million kilowatt-hours at present. The present total installed capacity of Federal hydro-electric plant is about 7000MW, and there is an additional capacity of 444MW in the T.V.A. steam plants. Federal power plant actually under construction at present is estimated to represent a total capacity of 6000MW.

The New York Central Railroad

Following an order placed earlier this year for 185 diesel-electric units, the New York Central Railroad has announced the completion of arrangements to buy a further 200 diesel-electric units, at a cost of 31,000,000 dollars. This represents the largest order for locomotives ever placed by the company. The order is made up of four 22 0 h.p. passenger locomotives, forty-six frei ht locomotives within a 1500 h.p. to 1600 h.p. range and 150 shunting units within a 1200 h.p. to 1600 h.p. range. Deliveries are expected to begin early next year and to be completed during the third quarter of the year. With the addition of these new units, the railroad and its affiliates will have a total of 1255 locomotives with, altogether, more than 1,491,000 h.p.

Chromium Plating of Aluminium

A process facilitating the plating of chromium directly on to aluminium and not requiring the conventional intermediate applications of zinc, copper and nickel platings, has been developed by Cro-Plate, Inc. The process is based on a method of coating the aluminium with abrasive material, which is used in a wet blasting operation to protect the surface of the metal between the time it has

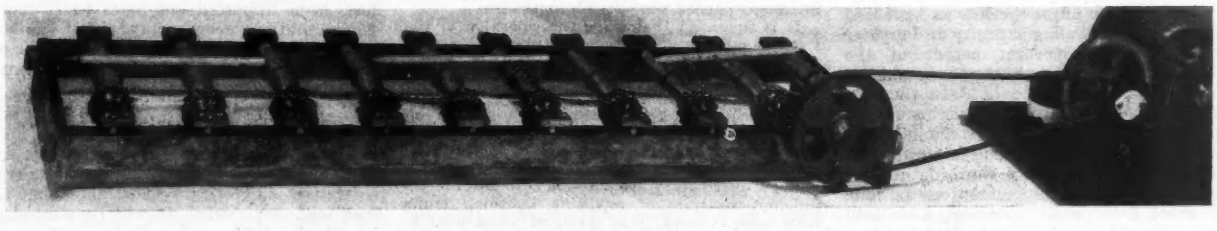


FIG. 2—SELF-CENTRING ACTION DEMONSTRATED ON A MODEL RUN-OUT TABLE

been mechanically cleaned of both dirt and oxides and its immersion in the plating bath. Initially the metal is wet-blasted by a hard and chemically inert quartz crystal abrasive suspended in water. The cube-shaped crystals not only remove the oxide from the surface of the aluminium upon impact, but also create a multitude of microscopic hills and valleys as they clean and smooth the surface. This action results in a considerable increase in the surface area of the metal, which, in turn, facilitates a more effective bonding action between the plated coating and the base metal. After being blasted, the metal surface retains a coating of the abrasive suspension thick enough to prevent any atmospheric action on the aluminium during the interval required between blasting and immersion in the plating tank. Once in the acid bath, the coating of quartz crystals washes away from the aluminium surface and settles down at the bottom of the tank. To avoid unnecessary delay, the blasting machine is placed in close proximity to the plating tank. Chromium has been deposited on aluminium at the rate of 0·007in to 0·008in per hour by means of a special high-speed plating solution used in conjunction with the process. The coatings deposited have shown hardnesses between 75 and 82 Rockwell C. The advantages of improved wear resistance, higher impact value and reduced surface friction of chromium-plated aluminium parts are expected to lead to their increasing application, particularly in the aircraft industry.

Authorisation of Reclamation Projects

During the session which has just ended, the Congress of the United States authorised the expenditure of approximately 195,023,000 dollars for federal reclamation projects. This authorisation provides for about 200,000 additional kilowatts of installed hydro-electric power capacity and more than a million additional acres of irrigated land intended for the settlement of ex-Servicemen. The major part of the work authorised is situated in the State of Idaho. The Palisades project calls for the construction of a rock-faced earth-fill dam of 2200ft crest length and 273ft height on the main stem of the Snake River, about 80 miles west of the Idaho-Wyoming border. The Palisades reservoir is expected to have a total capacity of 1,420,000 acre-feet and the project will eventually have a capacity of 112,500kW. Other authorised construction work in Idaho includes the installation of additional pumping plant for the Minidoka project, to provide for the irrigation of 77,650 acres of public desert lands, and the installation of an additional 30,000kW of generating capacity at the American Falls power station, mainly intended to provide the energy required for the above pumping plant. In the State of California, due to the authorisation, more than 195,000 acres of land along the Sacramento River will be provided with irrigation water, as part of the Central Valley project. In addition, a canal distribution system will be constructed, which is intended to supply water for industrial and domestic use in several counties of Northern California.

Baldwin-Westinghouse Diesel-Electric Locomotives

Following the acquisition by the Westinghouse Electric Corporation of a large part of the stock of the Baldwin Locomotive Works some time ago, a range of "Baldwin-Westinghouse" diesel-electric locomotives has been developed. This first major revision of all models of the company since the end of the war has led to such improvements as increased flexibility, greater hauling capacity and greater availability. An important aspect of the revision is a high degree of interchangeability, which has been maintained between the new and the existing locomotives, permitting owners of the latter to take advantage of the improvements. The range of locomotive units now includes 800 h.p. and 1200 h.p. shunting engines, 1600 h.p. "all service" locomotives in four or six-wheel, four or six-motor types, a 2400 h.p. transfer locomotive and a 1600 h.p. freight locomotive unit, which can be operated in multiples to form 3200 h.p., 4800 h.p. or 6400 h.p. locomotives. Engine changes, which have been introduced to ensure reliability and performance at the higher locomotive powers, affect the design of the bedplate, the crankshaft and bearings, the connecting rods and the turbo-charger. The stiffness of the bedplate has been increased and members of the main locomotive frame are now being made of alloy steel. The crankshaft has been increased in size at both the main and the crankpin journals and has been counterweighted and balanced dynamically to eliminate vibration. The web thickness has been increased and greater rigidity has been obtained by introducing more overlap between the crankpin and the main journals. Interchangeability of the old and new shafts has been achieved by utilising thin "strip process" copper-lead bearings. The new turbo-charger will operate at a higher blower pressure and its capacity has been increased to maintain full engine horsepower output at altitudes of up to 8000ft. The majority of these changes have been proven in test operations on a number of selected American railways.

A Coal-Burning Gas Turbine-Electric Locomotive

The Allis-Chalmers Manufacturing Company, of Milwaukee, Wisconsin, has delivered to the Alco Products Division of the American Locomotive Company, at Dunkirk, New York, what is believed to be the world's first coal-burning gas turbine for a locomotive application. The design of this unit results from several years' experiments (conducted by Bituminous Coal Research, Inc.) on the operation of model gas turbines burning powdered coal. The Allis-Chalmers turbine is stated to be capable of developing 4100 h.p. It is proposed to follow the standard design of current American diesel-electric locomotives by using the gas turbine to drive a direct-current generator, which, in turn, will furnish power to the motors on the driving axles. Once the locomotive installation has been completed successfully it is hoped to run road operation tests. The entire development project is financed by a number of railway and coal mining companies.

Continuous Casting of Steel

A new company, Continuous Metalcast Corporation, has been formed to exploit the continuous metal casting process developed by Irving Rossi. In the past the process has been used on a commercial basis in the production of brass, and, to a limited extent, on certain kinds of copper. The new company is to undertake development work with a view to adapting the Rossi process to the continuous casting of steel, a field in which certain preliminary work has already been done by the Allegheny-Ludlum Steel Corporation, of Pittsburgh.

Technical Reports

The Collection of Lightning Fault Statistics on Overhead Lines (Ref. S/T63). By R. H. Golde, Ph.D., M.I.E.E. The British Electrical and Allied Industries Research Association. Price 7s. 6d., postage 4d.—To obtain statistical information on faults due to lightning a survey was initiated a few years ago with the active co-operation of several supply undertakings, both in the British Isles and in the Commonwealth, and, since vesting date, with several Area Boards of the British Electricity Authority. The present report was prepared for submission to the C.I.G.R.E. Conference, held in Paris in 1950, with a view to acquainting interested parties with British experience.

It is suggested that while the collection of the required information on each lightning fault should be done by the maintenance personnel of the participating regional supply undertakings, the analysis should be left to a central national analysing body. In this way the incoming information can be treated on a uniform basis. In view of the inherent technical differences between high-voltage transmission systems (33kV and above) and medium-voltage distribution systems (3kV to 33kV) two different methods of reporting lightning faults have been evolved. The standard forms used in the British investigation are reproduced and the method of analysis is discussed.

French Engineering News

(From our French Correspondent)

In a memorandum sent by the Electricité de France to the Economic Council, it is pointed out that the margin of output is less than 15 per cent over the highest consumption figure at any given time. This margin is a minimum, taking into account that at any moment an extremely cold spell and a fall in hydro-electric production may cut supplies while increasing consumption. Electricité de France has asked the Economic Council to realise the importance of the nationalised electricity organisation receiving a priority for construction, over other enterprises, in order to maintain a safe margin of production over consumption.

Last September, electricity consumption increased to a figure 10 per cent over that of September, 1949. If Electricité de France is able to supply all the demands for current this winter and without load shedding, it will be due, the memorandum says, to the constant rain, which has aided the continuation of hydraulic power production. The reservoirs were 90 per cent full at the end of the summer.

It is expected that in 1950 some 33 thousand million kWh will be supplied by Electricité de France, which is 1 thousand million more than its guaranteed production. It hopes that equilibrium will be reached in 1951, 1952 and 1953, when guaranteed production should increase to 34·5 thousand million kWh, 38·5 thousand millions and 42 thousand million kWh, respectively. But it is pointed out that during the period reviewed the rearmament programme will expand and consumption will be greater.

Finally, the note says that nothing further can be done to increase production beyond the guarantee in 1951 or even in 1952, but it asks that the projects considered in 1951 be put into immediate execution so as to increase production by the end of 1953. This is not a question of setting up a new plan for the next five years, but of getting work under way immediately in order to produce the quickest possible results.

* * *

Monsieur Raspail, President of the Coal Importer's Committee, recently stated that France would have to import at least 15 million tons of coal in 1951. He said the seven to nine million tons proposed by the government would be altogether insufficient if the heavy industries were to carry on and the domestic consumer was to receive sufficient supplies.

The President regretted that neither Germany nor Britain would be able to furnish the necessary supplies and said that only America could help.

* * *

The government is reliably reported to have cut credits for the Charbonnages de France from £60,000,000 to £50,000,000. The credit reduction means that the Charbonnages de France may have difficulty in continuing large-scale modernisation. This would ultimately mean that work already started would terminate in a dead loss and much of this work has already reached a stage where it must be continued. The Monnet Plan intended that £27,000,000 should be spent on this mines development work in 1950, but this amount has been cut to £16,000,000.

* * *

A new oil refinery opened at Rafal, in Algeria, is fed by sixteen wells at Gueterini, where three others are being sunk. Oil production at the new refinery is expected to reach about 40 tons daily. New boring equipment which has been imported can bore to a depth of 2500m and engineers estimate that the output of the field may be increased to 100 tons daily. The new refinery has a capacity of some 600 tons daily.

* * *

A Dutch company has agreed to finance, in part at least, important extensions to the Port of Agadir. The project now under consideration is expected to cost about one and a half million pounds. It will be started, it is hoped, in 1951, and will be completed by 1954.

Industrial and Labour Notes

British Overseas Trade

At the end of last week, the Board of Trade announced that exports of United Kingdom goods in November reached a record value of £211,900,000. That total was £9,700,000 above the October figure and £35,000,000 above the average for the first ten months of this year. In the two months, October and November, the monthly average value of exports was 14 per cent more than in the third quarter and 21 per cent more than in the first half of this year. The volume of November exports has been estimated at 181 per cent of the 1947 monthly average, compared with 177 per cent in October, and 161 per cent during the third quarter of this year. Exports of machinery and vehicles in November were greater than in October, and those of iron and steel were 20 per cent above the average for the third quarter of the year.

Imports during November have been valued provisionally at £234,500,000, and re-exports at £10,300,000. The excess of imports (valued c.i.f.) over exports and re-exports (valued f.o.b.) was therefore £12,300,000, an increase compared with the October figure of £11,400,000, but a figure well below the average for the first ten months of the year (£29,300,000). Taking the period January to November this year, the provisional value of imports to the United Kingdom was £2,364,300,000, compared with £2,083,200,000 in the corresponding period of 1949, and total exports this year reached a value of £2,059,200,000 against £1,684,700,000 in the first eleven months of 1949. At the end of November, therefore, the excess of imports over exports was £305,100,000, compared with £398,500,000 at the corresponding date last year.

About exports to North America, the Board of Trade reports that the provisional value of United Kingdom goods sent to the U.S.A. in November was £13,800,000, which was £600,000 more than the record October figure, and £5,000,000 above the average for the first ten months of the year. November exports to Canada reached a value of £14,500,000, being £2,400,000 more than in October and £4,400,000 above the average for the first ten months of this year.

Aluminium Supplies

The Ministry of Supply has stated recently, that arrangements have now been made with the Aluminium Company of Canada, Ltd., for the supply to the United Kingdom in 1951 of 50,000 metric tons of virgin aluminium, in addition to the 150,000 metric tons already promised under contract. The Aluminium Company has also undertaken to supply 220,000 metric tons a year in 1952 and 1953.

The Ministry says that the Government has agreed to fund afresh, over a period of twenty years, the loans made to the Aluminium Company during the war to finance the expansion of capacity in Canada, and to make a new loan to the company of 25,000,000 dollars towards financing further expansion. The Aluminium Company will give the United Kingdom a first call on 200,000 metric tons a year of its production for twenty years. The Ministry claims, therefore, that adequate provision has been made for the increasing aluminium requirements for defence and for essential civilian production. This does not imply, however, that aluminium supplies to industry will be unrestricted.

Anglo-Swedish Trade

Discussions have been taking place recently in London between a Swedish trade delegation and officials of the United Kingdom Government about trade arrangements between the two countries for 1951. The Board of Trade says that imports into the United Kingdom from Sweden next year are expected to include substantial quantities of timber, pulp, paper, iron ore and other raw materials, the total value of imports being estimated at between £65,000,000 and £70,000,000, compared with rather less than £60,000,000 this year.

For a large proportion of United Kingdom exports there is no restriction on importation into Sweden. For the remainder, quotas are being granted by the Swedish authorities which should enable most exporters in this country—and particularly those in the machinery and textile industries—to maintain the trade at least at this year's level of about £75,000,000, a figure considerably in excess of those of preceding years. In addition, the Board of Trade says that provision has been made for the trade discussions to be renewed in the course of next year, at the request of either Government.

The Nickel Industry

A review of the Canadian nickel industry in 1950 has just been made by Dr. John F. Thompson, president of the International Nickel Company of Canada, Ltd. He stated that, in spite of the fact that nickel has been in tight supply during the latter half of this year, the amount available for distribution and for Government stockpiling has been the largest in any peacetime year in the history of the Canadian nickel industry. Dr. Thompson said that nickel output by Canadian producers for the year 1950 was expected to be about 250,000,000 lb, and, at present, production of the International Nickel Company of Canada, Ltd., was running at the average level of the war years.

Although nickel, like other metals, remained in short supply, Dr. Thompson continued, military requirements were being met in full and deliveries were being made to Government stockpiles. Nevertheless, he commented, civilian requirements continued to take the major portion of the world's nickel supply. Dr. Thompson referred also to an order, issued on December 2nd, in the U.S.A. by the National Production Authority, limiting the non-military consumption of nickel in the first quarter of 1951 to 65 per cent of the average quarterly rate in the first six months of 1950. That order, he said, was stated to be intended to maintain equitable distribution, through normal channels, of the amount of primary nickel remaining after meeting national defence requirements.

Dr. Thompson went on to say that the International Nickel Company's production during the past six months had been maintained at maximum capacity. It had been possible through a development and expansion programme, designed to provide greatly increased underground ore facilities, to replace open pit ore depleted during the second World War. In recent years, he indicated, mining development and expansion programmes had entailed an expenditure of about 90,000,000 dollars, of which more than 40,000,000 dollars had been spent since the end of the war. The programme, Dr. Thompson added, would require further large capital expenditures during the next few years to ensure the maintenance of current capacity production of nickel as the end of supplies from the Frood-Stobie open pits approached.

The T.U.C. and Rearmament

In a New Year message to the trade union movement, Sir Vincent Tewson, general secretary of the Trades Union Congress, says that the pace of events in the international sphere has brought into sharp relief the problems confronting the western democracies. Rearmament, on the scale demanded by such a situation, must necessarily impact heavily on the economics of a highly industrialised country like our own, which is still engaged, Sir Vincent comments, in the laborious task of national rehabilitation after nearly six years of total warfare.

Sir Vincent's message continues by pointing out that our national resources have been taxed almost to the limit, and "our reserves of manpower exploited to the utmost in an uphill struggle which has been a severe test of the mettle of our people." It is impossible, he says, "not to feel a sense of deep disappointment with a turn of events which has robbed us of the immediate fruition of our labours." But, Sir Vincent emphasises, the danger to world peace cannot be ignored, and our obligations cannot be evaded, although the cost in terms of money and manpower is inevitably high. The weight of the economic burden, he says, depends to some extent on our own efforts, and the key to the economic situation is still—as it has been for so long—productivity. The most must be made of material resources, time and labour, Sir Vincent concludes. Waste of all kinds must be avoided, through industry there must be created a greater national production, and exports must be maintained at the highest possible level. The message, therefore, calls upon all members of the trade union movement to do their utmost to meet the new crisis.

Railway Wages

As reported in these notes in our last issue, the Minister of Labour has set up a Court of Inquiry to investigate the wage claims made recently by the three railway unions and to make recommendations on the subject. At the end of last week, the membership of the Court was announced, as follows:—Lord Porter, P.C. (Chairman), who is a Lord of Appeal and also Chairman of the Coalmining National Reference Tribunal; Colonel H. C. Smith, Deputy Chairman of the Gas Council; Mr. A. J. Espley, formerly managing director of Timothy White, Ltd.; Mr. Lincoln Evans, a member of the General Council of the T.U.C., and General Secretary of the Iron and Steel Trades Confederation, and Mr. J. Crawford, a member of the General Council of the T.U.C., and General Secretary of the National Union of Boot and Shoe Operatives.

Coal Output

Figures issued by the Ministry of Fuel and Power show that the saleable output of deep-mined coal in the week ended December 16th was, at 4,563,400 tons, the highest achieved in any week this year. With the addition of 195,500 tons from opencast workings, the total output for the week was 4,758,900 tons, compared with 4,789,600 tons in the corresponding week of 1949. The coal production figure for the fifty weeks of 1950 up to December 16th was thus brought up to 209,444,600 tons, or rather more than 1,000,000 tons above the corresponding figure for 1949.

In the week ended December 9th, the Ministry reported another slight increase in coalmining manpower, the total number of wage earners on colliery books being 687,200, of whom 284,500 were working at the face. In that week also there was an improvement in the number of shifts worked, the figure per wage earner being 5·19, compared with 5·09 in the preceding week. Furthermore, voluntary absenteeism during the week ended December 9th was, at 5·83 per cent, slightly lower than in the preceding week.

Training for Industry

Under arrangements made by the Anglo-American Council on Productivity, the first of three teams formed to study education and training for industry sailed for the U.S.A. yesterday, December 28th. The team is under the leadership of Group Captain P. G. Thomson, general manager of J. Stone and Co., Ltd., and includes representatives of industrial management, trade unions, the Ministry of Labour, the Ministry of Education, and technical colleges. The industries represented by the team are engineering, transport, mining, building and textiles. The intention is to consider American methods for the training of operatives within industry and for industry in technical institutes, and also their further training with a view to promotion to more responsible work.

Personal and Business

MR. J. H. GIBSON, A.M.I.Mech.E., chief engineer of Dewrance and Co., Ltd., has been appointed a director of the company.

BIBLEC, Ltd., announces the appointment of Mr. Frank Tinker as Northern area manager, with headquarters at Surrey House, Arundel Street, Sheffield, 1.

HIGH DUTY ALLOYS, Ltd., Slough, announces the appointment of Mr. E. A. Gough as advertising and publicity manager in succession to Mr. J. Moore-Ogilvie.

MR. VAUGHAN PENDRED, until recently a director of the Skinningrove Iron Company, Ltd., has joined Head, Wrightson and Co., Ltd., to take charge of that company's sales organisation.

MR. V. J. CHALWIN, managing director of J. and H. McLaren, Ltd., Leeds, has been appointed managing director of Petters, Ltd., chairman of Bryce Fuel Injection, Ltd., and a director of Berger Equipments, Ltd.

MR. A. K. JORDAN has been appointed assistant general sales manager of Northern Aluminium Company, Ltd., Banbury. He has been associated with the Aluminium, Ltd., group of companies for the past twenty-one years.

THE LONDON DIVISION OF THE BRITISH ELECTRICITY AUTHORITY announces the retirement, after forty years' service in the electricity supply industry, of Mr. L. B. Dent, A.M.I.E.E., M.Inst.F., station superintendent at Islington generating station.

BRUSH EXPORT, Ltd., a company formed recently to handle the export business of the Brush Electrical Engineering Company, Ltd., is opening its own London office on January 1st at Duke's Court, Duke Street, St. James's, S.W.1, under the management of Mr. C. W. Glanister, M.I.E.E.

THE MANCHESTER SHIP CANAL COMPANY announces that, as from January 1st, Mr. C. E. Lucette, M.B.E., secretary of the company, becomes manager and secretary, and Mr. T. R. V. Edmondson, personal assistant to the managing director, becomes assistant manager.

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 24, Victoria Street, London, S.W.1.

DIMENSIONS OF HOUSINGS FOR HYDRAULIC SEALS

No. 1658 : 1950. For some time a need has been felt for guidance in the dimensions to be adopted for hydraulic seals, and this has now been covered by the issue of a standard. This publication lays down the basic dimensions for the standardisation of housings intended to accommodate hydraulic seals for use with reciprocating shafts where the friction caused by the seal is not of major importance and the working pressures do not exceed 5000 lb per square inch. It does not apply to seals for use on aircraft.

The standard deals with both long and short housings of the gland box and piston head types in the range of sizes from $\frac{1}{2}$in to 20in inner diameter and $\frac{3}{4}$in to 21in outer diameter. It stresses the desirability of consultation between the designer of the housing and the manufacturer of the seal in order that the correct tolerances may be applied to ensure satisfactory operation of the seal.

In addition to inner and outer diameters, axial lengths, tolerances in axial lengths, lead-on chamfers and fillet radii are specified. Although no tolerances are laid down for the inner and outer diameters of the housings, the standard will enable designers to choose the best basic dimensions to meet their needs and for which the proper seal will be available. The tolerances on diameter have been omitted because the variety of sealing materials and the range of application are such that hard and fast rules could not be made; hence the emphasis on consultation between design and manufacturer. Price 2s. post free.

COLD-DRAWN ELECTRICALLY WELDED MILD STEEL BOILER AND SUPERHEATER TUBES FOR DESIGN STEAM TEMPERATURES NOT EXCEEDING 850 DEG. FAH. (454 DEG. CENT.).

No. 1678 : 1950. This standard forms one of a series for boiler and superheater tubes. It provides for tubes manufactured from mild steel strip, resistance welded continuously by the passage of an electric current across the abutting edges. The steel strip shall be either hot or cold rolled and made from steel produced by the open-hearth or electric processes. Tensile limits of 20 tons to 28 tons per square inch are specified with elongations varying with thickness of tubes and form of test pieces. Flattening and expanding tests are also stipulated, together with permissible variations on thickness and diameter. Price 2s. post free.

Notes and Memoranda

Rail and Road

BRITISH MOTOR VEHICLE PRODUCTION.—The Society of Motor Manufacturers and Traders has announced that British motor vehicle output in October was at a weekly average of 11,350 cars, a record figure, and 5470 commercial vehicles. October exports achieved an all-time record for the value of any single monthly shipment of commercial vehicles in the history of the industry, amounting to £6,200,000. The volume of units consigned in that month was 36,790 cars, and 13,530 commercial vehicles. The number of agricultural tractors made in October, a total of 11,280, was the highest figure this year.

Miscellanea

A.C.E.C. REVUE.—We learn from the Ateliers de Constructions Electriques de Charleroi, 56, Victoria Street, London, S.W.1, that the company's house journal, *A.C.E.C. Charleroi*, is to be published henceforth in English as well as in French. It is intended that the English edition shall appear within three months of the French edition.

IMPORTED ELECTROLYTIC COPPER PREMIUMS.—The Ministry of Supply has stated that, as from January 1, 1951, its selling prices for imported electrolytic copper in special shapes and to special specifications will be subject to revised additions per ton to the basis price of copper. Details of the additions can be obtained from the Directorate of Non-Ferrous Metals, Ministry of Supply.

LOST COAL TONNAGE.—A recent Parliamentary answer by the Minister of Fuel and Power stated that, in the six months ended December 2nd, the total tonnage of coal lost by recognised holidays was 4,895,000 tons; by stoppages through disputes, 562,000 tons; by stoppages through accidents, breakdowns and machinery repairs, 150,000 tons, and by stoppages due to other causes, 73,000 tons.

LONDON UNIVERSITY APPOINTMENT.—Dr. Frederick Brailsford, M.I.E.E., has been appointed to the Chair of Electrical Engineering, tenable at University College, London, from January 1, 1951. For many years he has been a member of the research staff of the Metropolitan-Vickers Electrical Company, Ltd., and has served on the part-time staff of the Electrical Engineering Department of the Manchester College of Technology.

INSTITUTION OF MINING ENGINEERS.—The Council of the Institution of Mining Engineers has awarded the Medal of the Institution—its highest distinction—to Monsieur Etienne Audibert, Président, Charbonnages de France, and Directeur-Général, Centre d'Etudes et Recherches, in recognition of his distinguished services to mining engineering and of his achievements in research into safety in coal mines.

ARTS AND CRAFTS EXHIBITION.—A National Arts and Crafts Exhibition for the employees of the electricity supply industry and their families is to be held at the Old Horticultural Hall, Vincent Square, London, S.W.1, on February 15, 16 and 17, 1951. There have been thirty-one eliminating exhibitions throughout the British Isles, and from these the prize-winning and specially commended exhibits have come to London to form the National Exhibition.

JUNIOR INSTITUTION OF ENGINEERS.—At the recent annual meeting of the Junior Institution of Engineers, officers and members of council were elected as follows: chairman, Mr. P. B. Hebbert; vice-chairmen, Mr. N. E. Pillinger and Mr. S. R. Broderick; honorary treasurer, Mr. S. H. Hole; honorary editor, Mr. W. N. Staton-Bevan; honorary librarian, Mr. J. A. Roberts; members of council, Mr. A. J. Keeble, Mr. A. S. Ladley, Mr. R. H. S. Rose and Mr. J. R. Edwards.

OBITUARY.—We have learned with regret of the death of Mr. Colin Cunningham Scott, which occurred suddenly on December 7th, on a Glasgow-London train. Mr. Scott, who was seventy, was a director of the shipping firm of John Swire and Sons, Ltd., and until recently was chairman of Scott's Shipbuilding and Engineering Company, Ltd., Greenock. We regret also to have to record the death, on December 7th, of Mr. James Walker, secretary of General Refractories, Ltd., Sheffield.

ELECTRICAL MACHINES AND POWER NETWORKS.—Next session's post-graduate course in electrical machines and power networks, at the City and Guilds (Engineering) College, South Kensington, S.W.7, will include two series of fifteen afternoon lectures by Dr. J. R. Mortlock and Mr. B. Adkins, of the British Thomson-Houston Company, Ltd. Dr. Mortlock's lectures beginning on January 15th, will deal with some transient problems in electrical power networks, and those by Mr. Adkins, beginning on January 11th, will present a new approach to the general theory for analysing the performance of electrical machines.

SWEDISH IRONWORKS EXPANSION.—According to *The Anglo-Swedish Review*, the improvements at the Sandviken Ironworks, Sweden, started in 1946, are now nearly completed. A new hot rolling mill for strips up to 30cm wide has started production. It is said to be the first of its kind in Scandinavia and has a capacity of 18,000 tons a year. Another mill, with a capacity of 10,000 tons yearly of rolled tubing, is to start production shortly. Extensions to the cold rolling mill will bring its capacity for steel strip up to 18,000 tons a year.

MILLIONTH MOTOR MADE BY BROOK MOTORS, LTD.—Since the establishment of Brook Motors, Ltd., in 1904, the company has made more than a million electric motors. The millionth motor was presented, on December 16th, to the chairman and founder of the company, Mr. Ernest Brook, J.P. It was bought by small voluntary subscriptions from directors, staff and employees and was presented on their behalf by Mr. John Habron, who has been with the firm thirty-four years. The motor itself will be permanently exhibited in a display cabinet and will provide the power for operating a pneumatic tube system.

AGRICULTURAL ENGINEERING FILMS.—We were recently invited to a pre-view of some excellent films, covering many aspects of mechanised farming in this country and overseas, which have been produced for Harry Ferguson, Ltd., Coventry. The programme included "Farming Review," which depicts work on the reclamation of marginal land in Wales, and also shows effectively how mechanisation is being increasingly applied to the cultivation of the French vineyards. Other films in this new series are "Silage Sense" and "The Correct Approach," the latter portraying in detail the operation of the Ferguson tractor servicing system.

MINISTRY OF WORKS S.E. REGION OFFICE.—The Ministry of Works states that its South-Eastern Regional Director, Mr. S. J. Egerton-Banks, M.I.Mech.E., will retire on December 31st, and that the future of the South-Eastern Regional office has been reviewed in the light of present-day requirements. It has been decided that it is no longer necessary to maintain a separate organisation with a headquarters in Tunbridge Wells, and the regional office there will be closed on March 31st next. Questions affecting the building and civil engineering industries and building materials industries in the South-Eastern Region will be handled from the Ministry's headquarters at Lambeth Bridge House, London, S.E.1. Applications for building licences and statistical returns from builders will be dealt with by the London Licensing Office at 17, Cornwall Terrace, Regent's Park, N.W.1.

IRON AND STEEL INSTITUTE.—The Iron and Steel Institute has now made arrangements for the symposium on "High-Temperature Steels and Alloys for Gas Turbines" to be presented on Wednesday and Thursday, February 21st and 22nd next. The sessions, which will begin each day at 10 a.m. and 2.30 p.m., will be held in the hall of the Institution of Civil Engineers, Great George Street, London, S.W.1, and, following an introductory survey by Dr. N. P. Allen, the papers will be presented in seven groups. A dinner for those attending the symposium will be held at the Hyde Park Hotel, Knightsbridge, S.W.1, on Wednesday, February 21st, at 7 for 7.30 p.m. On the preceding evening, Tuesday, February 20th, the fifth Hatfield Memorial Lecture will be delivered in the York Hall, Caxton Hall, Westminster, S.W.1, at 8.30 p.m., by Air Commodore Sir Frank Whittle, F.R.S. His subject is "Turbine Problems in the Development of the Whittle Engine." Applications for tickets for the lecture and for particulars of the symposium should be made to the Secretary of the Iron and Steel Institute, 4, Grosvenor Gardens, London, S.W.1.

Launches and Trial Trips

RINGERD, motor tanker; built by Harland and Wolff, Ltd., for Mr. Olav Ringdal, of Oslo; length b.p. 460ft, breadth moulded 59ft, depth moulded 34ft 10in, deadweight 12,000 tons; Harland-Burmeister and Wain single-acting four-stroke diesel engine, six cylinders, 740mm diameter by 1500mm stroke. Launch, December 12th.

HREFNA, steam trawler; built by Hall Russell and Co., Ltd., for the Icelandic Government; length b.p. 183ft 6in, breadth moulded 30ft, depth moulded to upper deck 16ft; triple expansion engine, 1200 i.h.p. Trial, December 12th.

British Patent Specifications

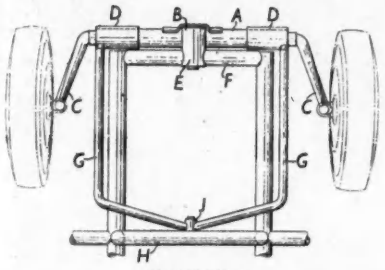
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.

Copies of specifications may be obtained at the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, W.C.2, 2s. each.

AUTOMOBILE ENGINEERING

644,176. April 14, 1948.—IMPROVEMENTS IN OR RELATING TO THE SUSPENSION OF MOTOR VEHICLES, Godfrey Dacre Jennings Ball, of 332, Old Laira Road, Plymouth, Devon.

The invention is intended to provide a means of suspension which combines transversely rocking axles, with independent suspension of the road wheels. In the drawing a front-axle suspension for a motor vehicle comprises a transverse axle *A* mounted to rock about a longitudinal central trunnion *B* and provided at each end with a pair of trailing links *C*. These links are splayed rearwards and upwards outwardly and arranged one above the other and connected to their respective wheels by a king pin. Each trailing link is connected to its end of the transverse axle *A* through an independent spring suspension, for example, by means of a rubber bush *D*. A similar rubber bush *E* may be provided as the trunnion at the centre of the transverse



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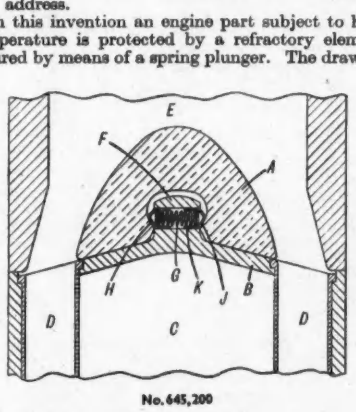
axle so as to limit and control movement about this axis as well as to locate the axle. The trunnion *B* or bush *E* connects the front axle to the front cross member *F* of the vehicle chassis frame. From the ends of the front axle *A* there extend rearwards a pair of torque arms *G*, which are bent inwards at their rear ends and connected to an arched cross member *H* of the chassis by means of a trunnion *J* which is arranged like the trunnion *B* on the longitudinal centre line of the chassis. These torque arms prevent any movement between the axle assembly and the chassis except for a limited angular movement about the longitudinal axis of the vehicle. The axes of the trunnions *B* and *J* preferably lie on a line which is above the centre of gravity of the loaded vehicle.—*October* 4, 1950.

AIR ENGINES

645,200. December 16, 1947.—IMPROVEMENTS RELATING TO ENGINES HAVING REFRACTORY ELEMENTS PROTECTING PARTS THEREOF FROM HEAT, The Birmingham Small Arms Company, Ltd., of Armoury Road, Small Heath, Birmingham, and John Fletcher, of the company's address.

In this invention an engine part subject to high temperature is protected by a refractory element secured by means of a spring plunger. The drawing



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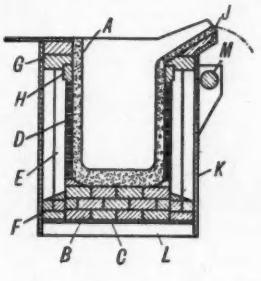
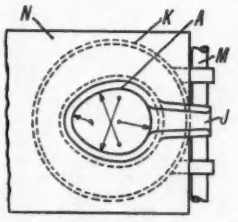
shows a hot-gas or air engine having a cylinder head with a refractory element. The element *A* is a dome-shaped block on top of a conventional cylinder head *B* of a hot-gas or air engine. The cylinder head constitutes the upper part of a hot chamber *C*, around which are located heater passages or chambers *D* communicating with the engine combustion chamber *E*, into which the flames from an external burner are directed. On the upper face of the cylinder head is a projection *F*, concentric with the cylinder and incorporating a cylindrical hole *G*. In the hole are two hollow conically headed plungers *H* and *J*, which are spring loaded in an outward direction through the coil spring *K*. The conical end faces of the plungers contact the wall of a suitably shaped aperture formed adjacent to the base of the refractory element. In order to attach the refractory block to the cylinder head it is only necessary to position the opening of the cavity in the block over the lug and apply a pressure sufficient to cause the plungers to be compressed by the rim of the annular wall. On passing the wall the plungers will spring outwards into contact with the wall of the cavity to hold the block firmly and securely on the cylinder head.—*October* 25, 1950.

ELECTRICAL ENGINEERING

644,751. September 15, 1948.—IMPROVEMENTS IN ELECTRICAL MELTING FURNACES, Allmanna Svenska Elektriska Aktiebolaget, of Vasteras, Sweden.

The melting pot for a high-frequency tilting type furnace described, is intended to make possible the construction of very large furnaces without increasing the strains on the bottom or the walls of the melting pot beyond the values normally accepted in such furnaces. In the drawings, *A* is a melting pot of refractory material, which rests at its lower end on supports *B* and *C* of brickwork. The melting pot is sur-





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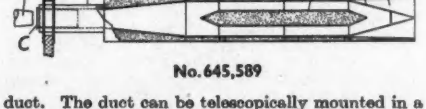
rounded by a coil *D* of a water-cooled copper pipe, and outside this coil a number of vertically laminated sheet metal members *E* are provided, which at their lower ends engage a ring *F* of brickwork. At the upper end the melting pot is surrounded by a flange *G* of brickwork, and between this flange and the upper end of the pipe coil *D* there is a ring of heat-insulating material *H*. The furnace is surrounded by a sheet metal housing *K* secured at its lower portion to a framework *L*, which supports the brickwork. The furnace can be swung about a shaft *M*. The top of the furnace is covered by a plate *N* extending to the edge of the melting pot. Various shapes of melting pots are also illustrated.—*October* 18, 1950.

AERONAUTICAL ENGINEERING

645,589. October 14, 1948.—NOISE-SUPPRESSING APPARATUS FOR USE IN CONJUNCTION WITH STATIONARY JET PROPULSION ENGINES, Douglas Jack Wayth Cullum, of 8–9, Flower's Mews, Archway Road, London, N.19.

In the drawing *A* is the jet engine exhaust which is located opposite an aperture in a wall *B*, through which is projected the leading end *C* of the detuner



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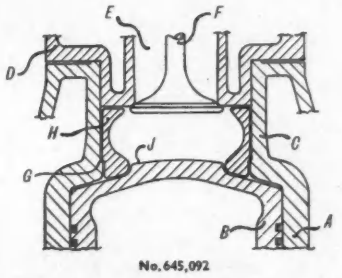
duct. The duct can be telescopically mounted in a main part *D* which leads to an entrance *E* of frusto-conical interior. The detuner part *E* extends into a second tubular part *F* which consists of a jacket having an interior sound-absorbing lining *G*, protected by a perforated liner. The rear or exit end of the detuner is closed by a perforated conical baffle plate *H*, which has a mouth flange secured to an annular shoulder *J* formed on the inner wall of the detuner as shown. The baffle is enclosed by an acoustically absorbent tube *K* which forms an extension of the detuner and, with the baffle, a diverging annular passageway *L* through which the gases discharge to atmosphere. Increased sound absorption is provided by a core *M* which is a hollow perforated metal cylinder filled with rock wool or other suitable sound absorbing material.—*November* 1, 1950.

INTERNAL COMBUSTION ENGINES

645,092. April 23, 1948.—TWO-STROKE COMPRESSION-IGNITION INTERNAL COMBUSTION ENGINE, N. V. de Bataafsche Petroleum Maatschappij of 30, Carel van Bylandtlaan, The Hague, Netherlands.

The invention enables a two-stroke engine of the type described to be provided in a simple manner with an uncooled combustion chamber insert. As shown in the drawing, the cylinder casing *A* contains the piston *B*, and at its upper end is the cylindrical extension *C*, in which is fitted the cylinder head *D*. In this head is the exhaust port *E* and exhaust valve *F*. The cylindrical extension has an inwardly projecting shoulder *G* on which rests the annular insert *H* forming the side wall of the combustion chamber, which, when the piston is at its top dead



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centre, is situated between the crown *J* of the piston and the exhaust valve. The ring is hollowed on the inside, so as to form a combustion chamber shaped to conform with the flow of air and combustion gases, both when they swirl inside the chamber and when they leave the chamber. The arrangement is such that the insert has some play in the cylindrical extension, to allow for thermal expansion and to leave a heat-insulating gap between the insert and the surrounding cooled parts of the cylinder and cylinder head. The insert, of a heat-resisting material, acquires, when the engine is in operation, a high temperature, which favourably affects the combustion process.—*October* 25, 1950.

645,368. November 3, 1947.—BEARINGS, The Cleveland Graphite Bronze Company, of 17,000, St. Clair Avenue, Cleveland, Ohio, U.S.A.

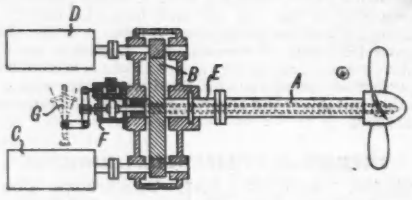
A bearing in accordance with this invention comprises a layer of substantial thickness of an aluminium alloy having bearing characteristics and a continuous layer not exceeding about 0·002in in thickness of a bearing composition containing lead or tin in predominant amount supported on and bonded to the surface of the aluminium alloy layer. Various aluminium alloys may be used for the aluminium layer of the bearings, and two compositions which have proven quite satisfactory are as follows:—Tin, 6 per cent; copper, 1 per cent; nickel, 1 per cent; titanium, 0·1 per cent; impurities, 1·5 per cent; balance, aluminium. A second alloy is composed of: tin, 6 per cent; copper, 1 per cent; nickel, 0·5 per cent; silicon 2·5 per cent; impurities, 1 per cent; balance, aluminium. As an example of the performance secured by a bearing of the type described the inventors state that they have operated a bearing consisting of aluminium without any steel shell, but carrying approximately a 0·001 per cent surface layer of a composition of approximately 8 per cent tin and 92 per cent lead. It has run more than 490 hours at a speed of 4200 r.p.m. and under a load of 3600 lb per square inch. At the conclusion of this run the bearing was examined and found to have worn less than 0·0004in, and there were no signs of fatigue or other unusual conditions indicating the likelihood of any early failure of the bearing.—*November* 1, 1950.

GAS TURBINES

644,534. June 9, 1948.—GAS TURBINE PLANT FOR THE DRIVING OF A PROPELLER SHAFT, Kaj Edvard Hansen, of 48, Blomstervænget, Lyngby, Denmark.

This specification describes a gas turbine plant for driving a propeller shaft with variable-pitch blades. In the accompanying drawing is shown a propeller with variable-pitch blades, the

propeller shaft *A* being bored longitudinally. *B* is a reduction gear which can comprise one or more steps and which is inserted between two gas turbines *C* and *D* and the propeller. A shaft *E* of the reduc-



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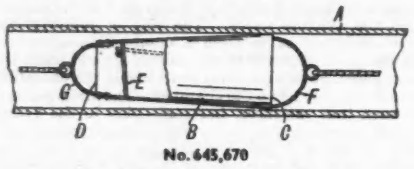
tion gear forms a continuation of the shaft *A* and is also bored longitudinally. On the side of the gear facing away from the propeller shaft there is mounted in line with the end of the shaft *E* a stationary servo-motor cylinder *F* with a piston which is connected by a pull rod to the propeller blades. The servo-motor piston is controlled by means of a slide valve connected by a lever to a regulating rod, which may be actuated by means of an operating lever *G* shown in dotted lines. A variation in the power output may also be effected by varying the pitch of the propeller blades, the gas turbine plant being provided as mentioned above, with a temperature regulator or a revolution regulator or both. The return motion of the slide valve is effected by a rod which is connected to the servo-motor piston.—*October* 11, 1950.

CIVIL ENGINEERING

645,670. October 13, 1948.—IMPROVEMENTS IN CLEANING DEVICES FOR PIPES, CONDUITS, AND THE LIKE, The General Descaling Company, Ltd., 289, Hanover Street, Sheffield, 3, and Leslie William Webb, of the company's address.

As shown in the drawing the device is adapted for the removal of sludge, waste or other deposit from an underground drain or similar conduit *A*. It comprises a bucket *B* of tapering form open at both



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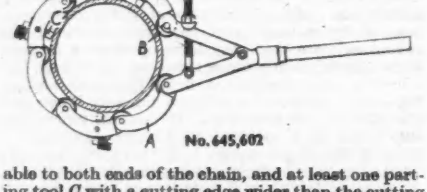
ends *C* and *D*, but closable adjacent its narrow end by a hinged flap *E*. The flap cannot move outward beyond its closed position. The ends of the bucket are provided with handles *F* and *G* provided with loops for the attachment of ropes. In use the bucket is drawn through the drain or conduit narrow end first, the flap maintaining it open by idling over the deposit. On withdrawing the bucket by pulling on its wide end, the flap closes the bucket, which becomes filled as it is withdrawn from the drain.—*November* 8, 1950.

TOOLS AND WORKSHOP APPLIANCES

645,602. November 11, 1948.—IMPROVEMENTS IN OR RELATING TO PIPE CUTTERS, C. and J. Hampton, Ltd., and Charles William Hampton, both of Record Tool Works, Sheffield, 2.

The pipe cutter comprises links *A* pivotally connected to form a chain bearing V-edged cutting wheels *B* with limited depth of penetration. A handle with chain-tightening means is attach-



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able to both ends of the chain, and at least one parting tool *C* with a cutting edge wider than the cutting wheels is located in the chain. When the tool is in use the V-edged cutting wheels form a shallow groove of sufficient depth to guide the tool on the pipe, but not so deep as to cause much plastic flow, the parting tool being set so as to come into contact with the pipe and start cutting before the cutting wheels have penetrated deeply. The parting tool skims off the raised lips formed by the V-edged cutting wheels and cuts out a ribbon of metal on either side of the groove, thus forming a flat groove into which the wheels enter to continue the formation of the shallow V-groove. Rotation is continued with periodical tightening until the V-edged cutting wheels finally break through, leaving only a small fin of metal at the edges of the cut surfaces. If one or more of the cutting wheels has two V-edges, the width may be nearly as great as that of the tools, the V-edges breaking through at both sides of the groove.—*November* 1, 1950.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

British Institution of Radio Engineers

Thurs., Jan. 4th.—N.W. SECTION: College of Technology, Manchester, "Marine Radar," G. W. L. Davis, 6.45 p.m.

Wed., Jan. 10th.—LONDON SECTION: School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, A Symposium on Hearing Aids, 6.30 p.m.——N.E. SECTION: Neville Hall, Westgate Road, Newcastle, "Stages in the Development of a Small High Frequency Oscilloscope," H. A. Bell, 6 p.m.

Electric Railway Society

Sat., Jan. 6th.—Fred Tallant Hall, Drummond Street, London, N.W.1, "A Glance at American Electrics," H. W. A. Linecar, 3 p.m.

Illuminating Engineering Society

Wed., Jan. 3rd.—NEWCASTLE CENTRE: Minor Durrant Hall, Oxford Street, Newcastle-on-Tyne, "Design of School Lighting," J. F. Roper, 6.15 p.m.——SWANSEA GROUP: 4, Northampton Gardens, Swansea, "Lighting of Departmental Stores," A. W. Jervis, 5.45 p.m.

Thurs., Jan. 4th.—CARDIFF CENTRE: S. Wales Electricity Board Demonstration Theatre, The Hayes, Cardiff, "Lighting of Departmental Stores," A. W. Jervis, 5.45 p.m.——EXETER GROUP: Agricultural House, Queen Street, Exeter, "Floodlighting," R. S. Hazell, 7 p.m.

Fri., Jan. 5th.—BATH AND BRISTOL CENTRE: S.W. Electricity Board Showrooms, Bath, "Floodlighting," R. S. Hazell, 7 p.m.——BIRMINGHAM CENTRE: Imperial Hotel, Temple Street, Birmingham, "Commercial Lighting of Big Stores and Shops," L. E. Gibbs, 6 p.m.——HUDDERSFIELD GROUP: Electricity Showrooms, Market Street, Huddersfield, "Lighting for High Speed Photography," J. Hadland, 7.15 p.m.

Mon., Jan. 8th.—LEEDS CENTRE: Lighting Service Bureau, 24, Aire Street, Leeds, 1, "Home Lighting," Miss M. Wardlaw, 7 p.m.

Incorporated Plant Engineers

To-day, Dec. 29th.—BIRMINGHAM BRANCH: Imperial Hotel, Temple Street, Birmingham, "Nylon Hosiery Manufacture," Bert Hall, 7.30 p.m.

Tues., Jan. 2nd.—S. WALES BRANCH: Grand Hotel, Westgate Street, Cardiff, Members' Plant Problems, 7.30 p.m.

Thurs., Jan. 4th.—PETERBOROUGH BRANCH: Eastern Gas Board's Demonstration Theatre, Church Street, Peterborough, Film, "Pulverised Fuel," D. J. U. Murray, 7.30 p.m.

Institute of British Foundrymen

Mon., Jan. 8th.—SHEFFIELD BRANCH: Royal Victoria Hotel, Sheffield, "Economics of Foundry Mechanisation," J. Blakiston, 7.30 p.m.

Institute of Industrial Supervisors

Tues., Jan. 2nd.—KIDDERMINSTER SECTION: Carpet Trades, Ltd., Mill Street, Kidderminster, Annual General Meeting and Section President's Address, 7.30 p.m.

Thurs., Jan. 4th.—COVENTRY SECTION: Geisha Cafe, Hertford Street, Coventry, Annual General Meeting and Members' Discussion Night, 7.30 p.m.——CARDIFF SECTION: Technical College, Clarence Street, Newport, "Joint Consultation—with Particular Reference to Supervisors," J. L. Hamilton, 7 p.m.——WARRINGTON SECTION: White Hart Hotel, Warrington, "The Foreman and Costing," S. C. Roberts, 7 p.m.

Tues., Jan. 9th.—NEWARK-ON-TRENT SECTION: County Technical College, Newark, Annual General Meeting and Section President's Address, 7.30 p.m.——DUDLEY AND DISTRICT SECTION: Technical College, Dudley, "The Manufacture and Use of Carbide Tipped Tools," H. F. Bates; Film, "The Wimet Age," 7.30 p.m.

Institute of Marine Engineers

Tues., Jan. 9th.—85, Minories, London, E.C.3, "Stress Analysis using the Brittle Lacquer Process," K. C. Rockey, 5.30 p.m.

Institute of Metals

Thurs., Jan. 4th.—BIRMINGHAM LOCAL SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham, Discussion on "Temperature Measurements," 6.30 p.m.

Institute of Petroleum

Wed., Jan. 10th.—26, Portland Place, London, W.1, Symposium on "The I.P. Safety Codes," presented by the I.P. Engineering Committee, 5.30 p.m.

Institute of Road Transport Engineers

Tues., Jan. 9th.—E. MIDLANDS CENTRE: Engineers Institute, Nottingham, "Electricity as Applied to P.S. and Heavy Goods Vehicles," 7.30 p.m.

Institution of Chemical Engineers

Tues., Jan. 9th.—Geological Society, Burlington House, Piccadilly, London, W.1, "The Sampling of Dust Laden Gases," C. J. Stairmand, 5.30 p.m.

Institution of Civil Engineers

Tues., Jan. 2nd.—Great George Street, Westminster, S.W.1, "Buildings for Air Transport Operators," R. G. Edkins, 5.30 p.m.

Tues., Jan. 9th.—Great George Street, Westminster, S.W.1, "Economics of the Maintenance of Highway Bridges"; "Steel Bridges," D. J. Davies; "Concrete and Masonry Bridges," R. E. O'Malley, 5.30 p.m.

Institution of Electrical Engineers

Fri. Jan. 5th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1, "Mechanical Handling," Joint Meeting with the Institution of Mechanical Engineers, 5.30 p.m.——N.E. STUDENTS' SECTION: King's College, Newcastle-upon-Tyne, "Research in Electrical Engineering," K. J. R. Wilkinson, 6.30 p.m.

Mon., Jan. 8th.—N.E. CENTRE: Neville Hall, Westgate Road, Newcastle-upon-Tyne, "The Cost and Efficiency of Earthing on Low and Medium Voltage Overhead Line Systems," L. Gosland, 6.15 p.m.——LONDON STUDENTS' SECTION: Savoy Place, Victoria Embankment, W.C.2, "Switchgear," L. Drucquer, 7 p.m.

Tues., Jan. 9th.—N. MIDLAND CENTRE: British Electricity Authority, 1, Whitehall Road, Leeds, 1, "The Continental Development of Single Anode Mercury-Arc Rectifier Valves of High Power," H. von Bertele, 6.30 p.m.

Institution of Engineers and Shipbuilders in Scotland

Tues., Jan. 9th.—39, Elmbank Crescent, Glasgow, "The Mechanical Engineering Research Laboratory, East Kilbride, Scotland," G. A. Hankins, 6.30 p.m.

Institution of Heating and Ventilating Engineers

Wed., Jan. 3rd.—E. MIDLANDS BRANCH: Gas Show Rooms, Nottingham, "District Heating in France," E. A. Pearce, 6.30 p.m.

Wed., Jan. 10th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1, "Contra-Rotating Axial Flow Fans," R. H. Young, 6 p.m.

Institution of Mechanical Engineers

Tues., Jan. 2nd.—COVENTRY A.D. CENTRE: Craven Arms Hotel, High Street, Coventry, "Some Factors Governing the Performance of Crankcase Lubricating Oils," A. Towle, 7 p.m.

Fri., Jan. 5th.—Storey's Gate, St. James's Park, S.W.1, "Mechanical Handling," Joint Meeting with the Institution of Electrical Engineers, 5.30 p.m.

Mon., Jan. 8th.—MIDLAND BRANCH, GRADUATES' SECTION: Victoria Hotel, Wolverhampton, "Engineering in a Rubber Works," D. A. Trafford, 7.30 p.m.

Tues., Jan. 9th.—AUTOMOBILE DIVISION: Storey's Gate, St. James's Park, S.W.1, "An Experimental Investigation into Pre-Ignition in the Spark-Ignition Engine," D. Downs and J. H. Pignéguy, 5.30 p.m.

Institution of Post Office Electrical Engineers

Tues., Jan. 9th.—Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2, "Local Line Development," R. M. Richards, 5 p.m.

Institution of Structural Engineers

Fri., Jan. 5th.—WESTERN COUNTIES BRANCH: Grand Hotel, Bristol, "The Reconstruction of the Colston Hall, Bristol," N. G. T. Ball, 6.15 p.m.

Institution of Works Managers

Tues., Jan. 2nd.—SHEFFIELD BRANCH: Grand Hotel, Sheffield, "The Works Manager," J. Ayres, 7.30 p.m.

Thurs., Jan. 4th.—BRISTOL BRANCH: Royal Hotel, Bristol, "Motion Study," A. B. Armstrong, 7.15 p.m.

Fri., Jan. 5th.—NOTTS AND DERBY BRANCH: Midland Hotel, Derby, "Production Efficiency via Time Study," J. W. Hendry, 7.30 p.m.

Junior Institution of Engineers

To-day, Dec. 29th.—39, Victoria Street, London, S.W.1, Film Evening, "Distinguished Company," "Wonder Jet," "Once Upon a Time," 6.30 p.m.

Wed., Jan. 3rd.—MIDLAND SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham, "Design in the Home," 7 p.m.

Fri., Jan. 5th.—WESTERN GROUP OF MEMBERS: College of Technology, Unity Street, Bristol, 1, "Materials in relation to Gas Turbine Design," K. L. Buckle, 7.30 p.m.——39, Victoria Street, S.W.1, Film Evening, "Prelude to Power," introduced by H. L. Greer, 6.30 p.m.

Mon., Jan. 8th.—N.W. SECTION: Manchester Geographical Society, 16, St. Mary's Parsonage, Manchester, Chairman's Address, "Factors in Efficiency," A. Eaton, 7 p.m.

Manchester Association of Engineers

Fri., Jan. 5th.—Engineers' Club, Albert Square, Manchester, "Automatic Welding," E. Hindson, 6.45 p.m.

Stephenson Locomotive Society

Sat., Jan. 6th.—LEEDS CENTRE: Y.M.C.A., Albion Place, Leeds, "Two Hours in London," W. A. Tuplin, 2.30 p.m.

END OF VOL. CXC

The Engineer

LONDON, FRIDAY, DECEMBER 29, 1950

The Engineer

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PUBLIC NOTICES

E TRAINING OF TECHNICAL TEACHERS

ications are invited from men of approxi- 25 years of age and over, for admission to -YEAR COURSE of TRAINING as FULL- TEACHERS of Engineering and Allied ts in Technical Colleges and similar tions.

licants should have a University Degree or Associate Member of a Professional Institu- or possess qualifications of the order of National Certificate or Full Technological ate of the City and Guilds of London te in the various branches of engineering, with suitable experience in industry.

ther particulars and application forms may ained from :

Director, Bolton Training College, Man- Road, Bolton, Lancs ; or

Director, Huddersfield Training College, Street South, Huddersfield, Yorks ; or

Director, Training College for Technical ers, North-Western Polytechnic, Prince les Road, London, N.W.5. E6111

Y OF SHEFFIELD EDUCATION COMMITTEE

COLLEGE OF COMMERCE AND TECHNOLOGY

ipal: G. LAWTON, Ph.D., F.R.I.C., A.M.I.Chem.E.

DEPARTMENT OF BUILDING

FULL-TIME TEACHER

plications are invited for appointment as L-TIME TEACHER, to take Day and ing Classes in Heating and Ventilating neering Practice and Heating and Ventilating neering Design to the level of the Final and Technological Certificate standards of the and Guilds.

pplicants should have had adequate industrial rience and possess one of the appropriate ired qualifications in heating and ventilating neering. Experience of technical college work irable.

ary in accordance with the Burnham her Education Scale with appropriate addi- for qualifications, training and experience. plication forms and further particulars may btained by sending a stamped, addressed -sized envelope to the undersigned, and should turned completed within two weeks of the arance of this advertisement.

STANLEY MOFFETT,
ucation Office, Director of Education.
Sheffield, 1. E6152

ERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

CITY AND GUILDS COLLEGE

SIX LECTURES

Course of SIX LECTURES will be given by bers of the staff of the British Welding arch Association on the design and fabrica- of machine elements and structures by ing, on Mondays, at 3 p.m., starting on ary 15th, 1951.

pplication for admission should be made to Deputy Registrar, City and Guilds College, hibition Road, London, S.W.7. E6157

LONDON TRANSPORT EXECUTIVE

PLANNING ASSISTANT

ondon Transport Executive invite applica- for a temporary post, estimated to be of six months' duration, of PLANNING ISTANT in the office of the Assistant Mech- al Engineer (Works) at Acton. The successful tant will be required to undertake duties isted with the compilation of a machine ing census.

pplicants should have had a sound general ation, technical education to National ificate standard and experience in process and uction planning, rate fixing and time study. nowledge of the overhaul and repair of rolling k would be an advantage.

mmencing salary will be according to age experience up to £420 per annum, with tional payments for certain recognised quali- ions.

he appointment is subject to a medical ination. Canvassing, directly or indi- y, will disqualify.

pplications, giving full particulars of age, rience, qualifications and present salary, uld be sent within fourteen days of appearance this advertisement to the Staff Officer EV.147), London Transport Executive, 55, adway, Westminster, S.W.1. For acknow- ment enclose addressed envelope. th September, 1950. E6154

PUBLIC NOTICES

LONDON COUNTY COUNCIL

HEATING AND VENTILATING ENGINEERS FOR HOUSING WORK

Applications are invited for positions of HEATING and VENTILATING ENGINEERS, at salaries up to £580 per annum or at higher salaries commensurate with ability and experience. Commencing salaries according to qualifications and experience. Candidates must have had experience in the design and preparation of working drawings, specifications and estimates for modern hot water heating, ventilating and hot water supply systems for houses and domestic multi-storey buildings, including communal halls, laundries and drying rooms. Preference will be given to applicants who are members of the Institution of Heating and Ventilating Engineers or equivalent.

Successful candidates will be engaged on a temporary basis, but will be considered for appointment to the permanent staff on the occurrence of vacancies. Superannuable.

Application forms from Director of Housing and Valuer (H.V.), The County Hall, Westminster Bridge, S.E.1 (stamped, addressed foolscap envelope required). Canvassing disqualifies. (1854.) E129

AIR MINISTRY

DESIGNER-DRAUGHTSMEN

Air Ministry have vacancies for DESIGNER-DRAUGHTSMEN in the Designs Branch of the Works Department in the following fields : reinforced concrete, structural steelwork, drainage and water supply, mechanical and electrical engineering. Vacancies are mainly in London, but there are some in the provinces. If desired, consideration would be given to making appointments for London only. Salaries are on ranges up to £625 with starting pay in accordance with age and qualifications. Applications, stating age, qualifications, previous appointments, with dates, should be sent to Air Ministry (S.2.H.), Cornwall House, London, S.E.1, from which address further details may also be obtained. E5617

PUBLIC NOTICES

ADMIRALTY

DRAUGHTSMEN

DRAUGHTSMEN experienced in all electrical engineering techniques are required for temporary service in the Electrical Engineering Department, Admiralty, at Bath.

Candidates must be British subjects of 21 years of age and upwards, who have had practical workshop experience (preferably an apprenticeship), together with drawing-office experience.

Salary will be assessed according to age, qualifications and experience within the range £283-£495 per annum.

Applications, stating age and details of technical qualifications and apprenticeship (or equivalents), and workshop and drawing-office experience, should be sent to Admiralty (C.E.II, Room 83), Empire Hotel, Bath, quoting "EED/DM." Candidates required for interview will be advised within two weeks of receipt of application. E6167

RIVER GREAT OUSE CATCHMENT BOARD

APPOINTMENT OF DEPUTY ENGINEER

Applications are invited for the post of DEPUTY ENGINEER from Corporate Members of the Institution of Civil Engineers, who should preferably hold a University Degree. They should have had considerable experience in administration and in the design and execution of river improvement and control works. The appointment is superannuable and is subject to the conditions of service of the National Joint Council for Local Authorities. The commencing salary is £1000 per annum, rising by four annual increments to £1200.

Application forms and further particulars may be obtained on request, and should be completed and returned to the undersigned before January 29th, 1951.

(Signed) K. M. RODDIS,
Clerk of the Board.

Elmhurst,
Brooklands Avenue, Cambridge,
13th December, 1950. E6078

PUBLIC NOTICES

LONDON TRANSPORT EXECUTIVE

TEMPORARY DRAUGHTSMEN

Applications are invited for posts of TEMPORARY DRAUGHTSMEN in the Planning and Methods Section of the Office of the Works Manager (Buses and Coaches), Chiswick Works.

Applicants must be speedy and accurate both at drawing and figuring and experienced in drawing-office work.

For vacancies in the section concerned with factory lay-out applicants must be familiar with overhaul methods and system of flow of work through workshops and be able to calculate shop capacity to suit stipulated outputs.

For vacancies in the jig and tool design section applicants should have practical experience in tool room and drawing-office, including knowledge of the types of jigs and fixtures used for sheet metal work and/or general machining of road vehicle parts.

Commencing salary will be according to age and experience up to £420 per annum, with additional payments for certain recognised qualifications.

The appointment is subject to a medical examination.

Applications, giving full details of age, training, experience and present salary, should be sent within fourteen days of the appearance of this advertisement to the Staff Officer (F/EV 158), London Transport Executive, 55, Broadway, London, S.W.1. For acknowledgment enclose addressed envelope.

9th December, 1950. E6153

BRITISH ELECTRICITY AUTHORITY

LONDON DIVISION

ASSISTANT ENGINEER (MECHANICAL WORKSHOPS)—DEPTFORD WEST GENERATING STATION

Applications are invited from engineers who have had a wide experience in general engineering and workshop practice.

The engineer appointed will be required to supervise the whole of the work of the mechanical machine shops, including machine tools, blacksmiths' shop, carpenters' shop, painters' shop, pipe fitting shop, tool stores, &c.

The successful candidate should have had as wide an experience as possible in machine shop work associated with the maintenance of power station plant and have a sound knowledge of welding technique.

Salary will be in accordance with the revised N.J.B. Schedule, Class "J," Grade 12, plus London allowance, equals £554 8s. per annum.

The appointment will be superannuable under the terms of the B.E.A. and Area Boards' superannuation scheme.

Applications, stating age, particulars of technical education, &c., should be sent to the Divisional Secretary, British Electricity Authority, London Division, Ergon House, Horseferry Road, Westminster, S.W.1, to be received not later than seven days after the appearance of this advertisement.

J. N. WAITE,
E6158 Divisional Controller.

BOROUGH OF WIDNES

TRANSPORTER BRIDGE

APPOINTMENT OF ENGINEER

Applications are invited for the above appointment. Salary at the rate of £1000 per annum.

Candidates should have a sound knowledge of mechanical and structural engineering and be qualified to supervise normal maintenance repairs and capable of directing and controlling the work of the mechanics employed on the bridge. Some knowledge of electrical work would be an advantage.

The successful candidate will work for a time in association with the General Manager, whose experience of the transporter bridge is being retained in the capacity of resident engineer. In due course the person appointed will take over the entire control and management of the bridge.

The Corporation have retained the services of an eminent London firm as their Consulting Engineers for the bridge.

Candidates should note that when the proposed new high-level road bridge is completed (possibly 8-10 years hence) the transporter bridge will cease to operate and be removed.

Applications, stating age, qualifications and details of experience, and accompanied by three testimonials, should be sent to me under cover, endorsed "Appointment of Bridge Engineer," not later than the 12th January, 1951.

FRANK HOWARTH,
Town Hall, Town Clerk.
Widnes,
4th December, 1950. E5968

CLASSIFIED ADVERTISEMENTS CLOSE FOR

PRESS — NOON TUESDAYS

The Engineer

Annual Subscription Rates

(including postal charges)

BRITISH ISLES	...	...	...	£4	10 0
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CHANGES OF ADDRESS

Will subscribers please note that in all advices regarding change of address it is necessary to have both old and new address, as our lists are kept alphabetically by towns. Advices of this nature should reach us by the first post Wednesday morning prior to the alteration.

Letters relative to the Advertisement and the Publishing Departments of the Paper are to be addressed to the Publisher: all other letters are to be addressed to the Editor of THE ENGINEER.

CLASSIFIED ADVERTISEMENT RATES

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Use of Box No.	2/- includes the cost of readdressing replies which are forwarded immediately on receipt. N.B. There is no charge for Box Nos. under "Situations Wanted."

Advertisements received by mid-day TUESDAY will appear in the issue of Friday the same week.

Orders must be accompanied by a remittance.

The Proprietors will not hold themselves responsible for Advertisers' Blocks left in their possession for more than two years.

Postal Address, 28, Essex Street, Strand, London, W.C.2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone - - - Central 6565 (10 lines).

PUBLIC NOTICES

UGANDA ELECTRICITY BOARD

GENERAL CIVIL ENGINEERING ASSISTANT

Applications are invited for the appointment of a GENERAL CIVIL ENGINEERING ASSISTANT in Uganda. Applicants should have had a good experience in surveying, levelling, preparation of working drawings for building and civil engineering works, and supervision of work being carried out by contract and direct labour.

Applicants should have passed either Sections A and B of the Associate Membership Examination of the Institution of Civil Engineers or the Testamur of the Institution of Mechanical Engineers.

Salary scale £580 : £580 by £40 to £780 per annum. Commencing salary will be determined according to experience and qualifications. In addition, free partly furnished accommodation or an allowance in lieu will be granted.

The initial contract will be for a period of three years. Free passages to and from Uganda are provided, plus three months' leave on full salary on termination of contract (or six months if contract is renewed).

Further information as to conditions in Uganda may be obtained from the Board's London Office, 129, Grand Buildings, Trafalgar Square, London, W.C.2.

Applications to reach Kampala by 31st January, 1951.

E. H. WILSON,
Secretary.

P.O. Box 559,
Kampala, Uganda,
E. Africa. E6185

CROWN AGENTS FOR THE COLONIES

ELECTRICAL ENGINEERS

ELECTRICAL ENGINEERS (Electrical Distribution) required by the Central Electricity Board, Federation of Malaya, for three years, with prospect of permanency. Salary (including expatriation pay), payable in local currency, equivalent at the present Government rate of exchange to £742 a year, rising to £1652 a year. Commencing salary according to qualifications and experience. Cost-of-living allowance equivalent to between £210 and £525 a year, according to salary and dependants. Free passages. Liberal leave on full salary. Candidates, between 24 and 35 years of age, must have had a good general education and be Corporate Members or Graduates of the Institution of Electrical Engineers (or the equivalent), and have had sound training in both electrical and mechanical engineering, with experience in the operation of medium electricity supply undertakings. They should possess a competent knowledge of the erection and maintenance of high and low-tension overhead and underground A.C. distribution systems and substation plant. Experience in maintenance and operation of diesel engines a distinct advantage. Candidates who possess the necessary academic qualifications but lack practical experience will be considered.—Apply at once by letter, stating age, full names in block letters, and full particulars of qualifications and experience and mentioning this paper, to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1, quoting M.25016.B. on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. E6192

PUBLIC NOTICES

HIS MAJESTY'S COLONIAL SERVICE, MALAYA

DEPARTMENT OF DRAINAGE AND IRRIGATION

ASSISTANT CIVIL ENGINEER

A vacancy has occurred in the Department of Drainage and Irrigation, Malaya, for an ASSISTANT CIVIL ENGINEER. The duties include surveys and preparation of designs for irrigation works and water control, execution of works by contract and direct labour.

Appointment will be on probation for permanent and pensionable employment in the incremental scale 430 dollars by 30 dollars to 900 dollars per month (£602 by £42 to £1260 per annum at present rates of exchange), initial salary depending on experience and war service. Cost-of-living allowance is payable at approved Government rates (present rates 50 per cent. of substantive salary subject to the following maxima :—£525 per annum for married officers with dependent children, £420 per annum for married officers without dependent children, £210 per annum for single officers). Expatriation pay, which is pensionable, is paid at rates varying from £126 to £231 per annum. Free passages for officers, and, if married, for their wives and children, are granted on first appointment and on leave. Generous home leave on full pay is granted after a first tour of three to four years, the length of tour decreasing with length of service. Malayan income tax is payable at low rates.

Candidates must be British subjects, aged preferably between 24 and 35. They must be exempt from, or have passed, Sections A and B of A.M.I.C.E., and have had at least two years' civil engineering experience. Preference will be given to those with experience gained in River Catchment Boards.

Engineers employed by local authorities in the United Kingdom can preserve superannuation rights.

For a form of application and further information, write, giving brief particulars of age, qualifications and experience, to the Director of Recruitment (Colonial Service), The Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1. Please mention this paper and quote No. 27329/24. E6177

TENDERS

EPPING URBAN DISTRICT COUNCIL

SOUTHERN SEWAGE DISPOSAL WORKS EXTENSIONS—CONTRACT No. 2

TENDERS are invited for the above work, comprising Two Sedimentation Tanks, Three Biological Filters, Two Humus Tanks, Sludge Digestion Tanks, Sludge Drying Beds, a Small Sludge Pumping Station, and all the appurtenant Pipework, Manholes, &c.

General conditions of contract, specification and bills of quantities may be obtained from the Council's Consulting Engineers, Messrs. J. D. and D. M. Watson, MM.I.C.E., 18, Queen Anne's Gate, Westminster, S.W.1, on and after Wednesday, 27th December, 1950, on payment of a deposit of Five Guineas, refundable only to contractors who submit a bona-fide Tender and return all documents and drawings. The deposit cheque should be made payable to J. D. and D. M. Watson.

Sealed Tenders, endorsed "Tender for Extensions to Southern Sewage Disposal Works," and bearing no name or mark indicating the sender, are to be delivered to the undersigned not later than noon on Saturday, 27th January, 1951.

The Council do not bind themselves to accept the lowest or any Tender.

B. HISCOTT,
Clerk to the Council.

Hawthorn Lodge,
91, High Street,
Epping, Essex. E6070

EGYPTIAN GOVERNMENT

MACHINERY FOR FIRE FLOATS

TENDERS are called for by the Director-General, Ports and Lighthouses Administration, Alexandria, for the SUPPLY and DELIVERY to Government Stores, Alexandria, of :—

MACHINERY for FIRE FLOAT No. 1, with diesel engines for propelling and pumping also, electrically driven pumps, &c. (Reference No. 74/P. & L.45/1/66/50.A.).

MACHINERY for FIRE FLOAT No. 2, of similar kind (Reference No. 74/P. & L.45/1/66/50.B.).

Tenders should be submitted direct to the Director General, Ports and Lighthouses Administration, Arsenal, Alexandria, Egypt, not later than Noon on the 27th of February, 1951.

Copies of the necessary conditions of Tender and specification can be obtained on application to the Chief Inspecting Engineer, Egyptian Government, 41, Tothill Street, London, S.W.1. The cost of the specification, &c., for each float is £2 1s., i.e., £4 2s. for the two. This sum must be prepaid and is not returnable. Cheques must be endorsed permitting transfer to an Egyptian Government account. Copies of these documents are also available for scrutiny at the above address. Separate applications under respective references must be made for each float. E6179

TO ADVERTISERS UNDER BOX NUMBERS IN SITUATIONS OPEN SECTION.

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APPLICATIONS are Invited by London Consulting engineers for the post of SENIOR MARINE ENGINEERING DRAUGHTSMAN. Applicants should be thoroughly conversant with the design of all types of dredgers, tugs, barges, and shallow-draught steamers. They should also be able to verify builders' working and "as-fitted" hull and machiner drawings and to draw up complete hull and machinery specifications in connection therewith; also to deal with all technical correspondence relating to contracts and usual drawing-office routine. Applicants should be aged between 30 and 40 and preferably possess First Class Board of Trade or Ministry of Transport Certificates and be members of the Institution of Naval Architects and/or Marine Engineers. Salary according to age and qualifications.—Applications, in writing, giving full particulars of qualifications, experience and age, should be forwarded not later than January 24th to Box No. 3858, c/o Charles Barker and Sons, Ltd., 31, Budge Row, London, E.C.4. E6168 A

APPLICATIONS are Invited for the Post of ACCIDENT PREVENTION OFFICER (Safety Officer) with a large organisation in Hull. Applicants should be between 35 and 45 years of age and have practical engineering together with a knowledge of the Factory Acts; they must be tactful and have a decidedly pleasant personality, be keenly interested in safety matters, hard working and able to evolve a long-term policy involving many spheres of activity. Commencing salary £750 p.a.—Address in first instance, stating qualifications, E6166, The Engineer Office. A

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SITUATIONS OPEN

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DESIGN ENGINEER Required by the English Electric Company, Ltd., Luton, for work on the design of aircraft structures. Preference will be given to applicant with Higher National Certi- ate in Mechanical Engineering and experience the aircraft industry. Responsible progressive t requiring initiative. Commencing salary 0/£700 p.a.—Apply, giving full details and oting Ref. 845, to Central Personnel Services, glish Electric Co., Ltd., 24/30, Gillingham eet, London, S.W.1. E6143 A

DESIGN ENGINEERS, with B.Sc. Degree in Mechanical Engineering or equivalent and over 40 years of age, are required by the rsia Petroleum Company, Limited. Experi- ce to have been in design of oil refineries, coal , chemical distillation or similar plants in- ving electrical and steam systems, pressure sels, fractionating columns, heat exchange d pumping equipment. Salaries according to alifications and experience, plus kit allowance, ovident fund. Free board and air-conditioned commodation, medical attention. Low living sts. Two-year agreements with paid leaves and nsportation.—Write, giving full particulars of th, education and experience, to Box 8795, c/o rin Barker and Sons, Ltd., 31, Budge Row, ndon, E.C.4. E355 A

DESIGNER and ESTIMATOR, Experienced in the production and application of centri- al sewage pumps, is required by South fordshire firm of pump manufacturers. pplicants should give particulars of previous perience, qualifications, if any, and salary re- ired.—Address, E3976, The Engineer Office. A

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DRAUGHTSMAN Required with Medium-powered diesel locomotive design experience.—Address, E6074, The Engineer Office. A

DRAUGHTSMEN Required by London Firm of chemical engineers. Experience in chemical plant design, detailing and lay-out preferred, but not essential. Good salary to the right men; five-day week; pension scheme.—Address, giving full particulars of experience, E4020, The Engineer Office.

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DRAUGHTSMEN, Seniors and Juniors, Required by firm of conveyor manufacturers. Preference given to men with experience in design and detailing of belt and chain conveyors and elevators. Good salaries plus profit-sharing bonus and pension scheme. Office at London and Erith.—Apply, Sovex Limited, St. John's Road, Erith, Kent. E4057 A

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DRAUGHTSMEN Required for Steam Turbine power station lay-outs at the Rugby Works of the English Electric Co. Work involves structural and foundation drawings, comprehensive machinery, pipe arrangements and associated details. Experience in similar work or in marine lay-outs preferred. Excellent staff conditions, including pension scheme.—Apply, giving full details and quoting Ref. 509D, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham Street, London, S.W.1. E6055 A

DRAUGHTSMEN, Having First-Class Experience in the preparation of mechanical and structural shop detail drawings, are required by West's Gas Improvement Co., Ltd., Columbia House, Aldwych, London, W.C.2. E316A

DRAUGHTSMEN, Aged 30-35, Required, with general mechanical experience. National Certificate essential. For work on machine design and services.—Apply, Personnel Manager, Fort Dunlop, Erdington. E6094 A

DRAUGHTSMEN, with Experience on all Sizes of power transformers, required by company in S.W. London. Pension scheme in operation and five-day week. State full details, past experience, technical education and salary required.—Address, E4034, The Engineer Office. A

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ENGINEER REPRESENTATIVES Required. Essential requirements are sound experience in centrifugal pump applications, ability to sell to higher engineering and purchasing executives, willingness to travel abroad, current driving licence. Full details of career, including present salary and age (preferably under 35), should be given in first instance.—Address, E5975, The Engineer Office. A

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FACTORY LAY-OUT DRAUGHTSMAN Required by large light engineering company in East London area. Applicants should have experience in the lay-out of machine and assembly shops, including the provision of all services. Good salary and permanent appointment is offered to the selected applicant. Please state full details including age and salary required.—Address, E6147, The Engineer Office. A

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INSPECTING ENGINEER.—Large Company engaged in the design and construction of oil refinery and chemical plant requires the services of an Inspecting Engineer possessing a sound knowledge of oil refinery construction methods and having specialised experience of welded pressure vessels built to A.P.I. Code.—Applicants should write, stating age, experience and salary required, and must be prepared to reside in the London area, to Box 3834, c/o Charles Barker and Sons, Ltd., 31, Budge Row, London, E.C.4. E5965 A

IF You Are Between 21 and 25 Years of Age, and have at least three years' electrical or mechanical engineering workshop experience, the English Electric Group are willing to consider you for TRAINING as a DRAUGHTSMAN. This paid training will be up to six months' duration to fit suitable applicants for employment as either Electrical or Mechanical Draughtsmen at Acton, Bradford, Chelmsford, Liverpool, Preston, Rugby or Stafford. Preference will be given to men who have reached O.N.C. standard of technical study.—Apply, quoting Ref. 842, to Central Personnel Services, English Electric Company, Limited, 24/30, Gillingham Street, London, S.W.1. E5961 A

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LEADING Company Requires Qualified ENGINEER (under 30) for Sales Staff in Ceylon. Candidates should have served recognised apprenticeship and have had some experience of diesel engines and pumps. Specialised training will be given before departure. Good salary commission and recognised leaves. Applicants must submit full details of training and experience, which will be treated as confidential.—Write, Box H. 150, Willing's, 362, Grays Inn Road, London, W.C.1. E6106 A

LEADING DRAUGHTSMAN Req'd by Constructional engineers, London area, to handle contracts and supervise detailers. Good salary for right man. Age, exp. and salary to "LEADER."—Address, E5985, The Engineer Office. A

LONDON FIRM of Mechanical Handling Engineers require a SENIOR MAN for their estimating office. Must be capable calculator and stress man. Good salary will be paid to a first-class man. Give age, education, training, experience and salary required.—Address, E6170, The Engineer Office. A

MECHANICAL ENGINEERS' DRAUGHTSMAN required for works engineers dept., to be experienced in lay-out of production plant and factory services (steam, hydraulic, air). Some mould and jig design experience would be an advantage. Five-day week and pension fund.—Apply, stating age, qualifications, details of experience and salary expected, to The Avon India Rubber Co., Ltd., Melksham, Wilts. E6188 A

MECHANICAL ENGINEERS, Aged 27 to 35, required by large industrial organisation for service in the Middle East. Candidates should have had a good general education and must possess a B.Sc. Engineering Degree with adequate experience or A.M.I.Mech.E., and must have served a suitable apprenticeship followed by at least four years' experience in design and provisioning of one or more of the following:—Chemical plants, large processing plant, power plant and auxiliaries, large pumping schemes and piping reticulations. Experience in controlling a small staff desirable, but not essential. Service with H.M. Forces will be given full consideration. Attractive salary according to qualifications and experience plus generous allowance in local currency, designed to assist substantially in meeting cost of living, free passages, kit allowance, free medical attention, generous leave, pension scheme.—Write, giving personal particulars and details of qualification and experience, quoting Dept. F.3, to Box 3210 at 191, Gresham House, E.C.2. E6164 A

MECHANICAL ENGINEERS Required by large oil company for service overseas. Candidates must have (a) five years' apprenticeship and possess the Higher National Certificate in Mechanical Engineering, or (b) two years' practical workshops experience with the following:—(1) An Engineering Degree and/or (2) be Graduates or Associate Members of the Institution of Mechanical Engineers. Candidates under category (a), age limit 23-28; under category (b), between ages 23-30. Married men under 26 years of age will not be considered for either category. Initial contracts three to four years. Commencing salary £590 p.a. upwards, according to age and qualifications; pension scheme benefits and local cost-of-living allowances; £75 outfit. Allowance first-class passages provided; excellent prospects of progressive career.—Apply in writing, giving age, with full particulars of education, qualifications and experience, to Box Z.O., 786, Deacon's Advertising, 36, Leadenhall Street, E.C.3. E168 A

OIL Refinery Contractors, Handling Large Contracts for refinery plant, require CONTRACTS ENGINEER in their London office. Duties involve broad direction and co-ordination of all phases of the work, including planning, draughting, purchasing, progressing and erection. Desirable qualification is previous experience of refining industry or heavy engineering including a wide knowledge of pumping, heat-exchange equipment and instrumentation, and the appointment offers excellent prospects to suitable men.—Applicants should write fully, stating qualifications, age and experience, to Foster Wheeler, Ltd., 3, Ixworth Place, London, S.W.3. E356 A

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PEST CONTROL, Limited, of Cambridge, Have vacancies for qualified ENGINEERS with sound practical and theoretical knowledge of general engineering, for interesting work of both experimental and production nature; age limit 35 years. Salaries according to qualifications.—Write, giving full particulars to Personnel Manager, Pest Control, Limited, Bourn, Cambridge. E6174 A

PETER BROTHERHOOD, Ltd., Peterborough, require DRAUGHTSMEN (Senior and Junior), preferably with experience in design of compressors, turbines and steam engines. Permanent positions, five-day week, staff pension scheme.—Write, giving full details age, experience and salary required E342 A

PETROLEUM Refinery Contractors Require qualified MECHANICAL ENGINEER (degree standard) for design work in their technical department.—Apply, giving full details, to Head Wrightson Processes, Ltd., 24/26, Baltic Street, London, E.C.1. E6169 A

PLANT DEVELOPMENT and PROCESS ENGINEERS, qualified in chemical engineering or petroleum refining technology, required by Bahrein Petroleum Company, Limited. Age limit 25-40. Two-year agreement periods with passages and paid leaves. Free air-conditioned accommodation, board and medical attention, kit allowance, low living costs. Salary according to experience.—Write, with full particulars of age, education, experience, to Box 3784, c/o Charles Barker and Sons, Ltd., 31, Budge Row, London, E.C.4. E354 A

PRODUCTION MANAGER Required for important engineering firm in the Medway area. The successful applicant must be fully experienced in the assembly of precision mechanisms and rotating structures. Position is an important one and offers scope for advancement. Submit details of experience, age and salary expected.—Address, E6114, The Engineer Office. A

RATE FIXERS Required for Engineering Work. Must have experience of rate fixing in prototype, tool room, production machine shop and assembly. Salary £450-£550 per annum.—Write, stating age, qualifications and experience, to the Personnel Officer, Sir George Godfrey and Partners, Ltd., Hampton Road, Hanworth, Middlesex. E6186 A

For continuation of Small Advts., page 4

PITMAN

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NISSEN Type HUTS, Ex-Government Stock, reconditioned and supplied ready for erection. All sizes in 6ft. multiples; 36ft. by 16ft., £71 10s. and £59 8s.; 24ft. by 16ft., £50 12s. and £41 16s.; 72ft. by 16ft., £134 4s. and £106 14s.; delivered U.K. Plasterboard Huts and other Buildings. Some 24ft. span Nissens.—Write, call or telephone, Universal Supplies (Belvedere), Ltd., Dept. 63, Crabtree Manorway, Belvedere, Kent (Telephone No., Erith 2948). E130 G

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New Alba 18in. Shaper, model 4S, 415/3/50.
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Cleveland type B Autos., 1¼in. cap., and model 8A, ¾in. cap.
Mikron Gear Hobber, 1¼in. centres by 2¼in. between, 400/3/50.
Broom and Wade Air Compressor, 100 lb. pressure, 400/3/50.
Herbert No. 4 Capstan Bar and Chucking, 400/3/50.

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NEW Marine REVERSE REDUCTION GEARBOXES for sale, well-known make, covering 200 to 570 H.P., speed ratio 2 : 1, for engine speeds from 355 to 600 r.p.m. Complete list sent on application. What offers?—Address, E6190, The Engineer Office. G

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RECONDITIONED MACHINERY FOR SALE.

STEAM BOILERS.—Paxman Economic, 14ft. by 8ft., new 1939, 150 lb.; Lancashire, 28ft. by 7ft. 6in., 160 lb.; twelve Cochrans, 5ft. to 7ft. diam.; 300 second-hand Cross Tubes, every size; brand new Cross Tubes, 3ft. to 6ft. dia.

AIR COMPRESSORS.—Ingersoll-Rand, 450 cu. ft.; C.P.T., 320 cu. ft.; Broomwade, 220 cu. ft.; Holman, 100 cu. ft. all motorised, 100 lb. pressure.

200 Air Receivers stocked, including four 8ft. by 4ft. 3in. by 250 lb.; three 24ft. by 4ft. 6in. by 150 lb.; twenty, 7ft. by 3ft. 4in. by 100 lb.; all tested and guaranteed.

DIESEL ENGINES.—Twenty Lister, 3-cyl. and 4-cyl., vertical, as new, 30/40 H.P.; Ruston, 90 H.P., vertical; 60 H.P. National horizontal cold starting; 120 National horiz. twin.

CRANES.—5-ton Tate mobile petrol-electric, new 1942, three in stock; 3-ton Jones mobile, slewing, diesel driven (three); 3-ton Morris hand-operated, swan-neck jib; 2-ton Chasesides, pneumatics (two); 3-ton Smith steam loco., 40ft. jib; 5-ton Taylor Steam Loco. Cranes, 40ft. jibs, 1942 (two); 5-ton Butters Electric Derrick, jib 80 ft. 1942, unused.

GENERATING SETS.—20-kVA Lister diesels, 230/3/50 supply, practically new; 15-kVA Lister diesels, 440/3/50 and 230/1/50 supply; 18-kW Ruston diesels, 110 volts D.C., trailer mounted; new 1½ and 5-kVA petrol, 230/1/50 output.

RAILWAY MATERIAL.—Kerr 12in. by 20in. six-wheel coupled Steam Loco., 160 lb. W.P.; Stephenson four-wheel coupled, new 1946, available from hire March, 1951; 2000 yards 20 lb. track, 2ft. gauge, with turntable, points, wagons.

ELECTRIC MOTORS.—300 H.P., G.E.C., S.R., 334 r.p.m.; 60 H.P., G.E.C., S.R., 480 r.p.m.; 50 H.P., Harland, T.E., S.R., 1460 r.p.m.; 35 H.P. and 45 H.P. Laurence Scott, T.E., S.C., flameproof, 990 r.p.m.

STEEL PIPING.—400 feet 18in. flanged steam tubes; 600 feet 14in. by ¼in. high-pressure steel; 200 feet 12in. flanged steel steam column; 4000 feet 10in. steel, ¼in. thick, 18/20 feet; 30,000 feet 6in screwed well lining, 18/20 feet; 20,000 feet 6in. Victaulic, with joints; 500 steel bends, 6in., 8in. and 10in.

WHEEL VALVES.—40 each 6in. and 4in. high-pressure steel wedge Fullyway, ex Pluto; Hopkinson 6in., 8in., 10in., 12in., parallel slide; 5000 sluice valves, all sizes.

Comprehensive catalogue—"Watkins Machinery Record," published monthly; free copy on request.

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COLEFORD, GLOS.
'Phone : Coleford 2271/2. E366 G

600

HYDRAULIC PLANT

1800-ton Upstroke Press, by HUGH SMITH, working space 8ft. 2in. by 4ft. 4in., daylight adjustable 5in./24in., W.P. 2240 lb.

433-ton Upstroke Press, by JOHN SHAW, working space 5ft. by 3ft. 5in., daylight 2ft. 8in., Hele-Shaw pumping equipment.

400-ton Triple-Ram Upstroke Flanging Press, 9ft. 9in. by 9ft. 6in. between columns, daylight adjustable 3ft./10ft., W.P. 1500 lb.

350-ton Upstroke Forming Press, by BERTRAMS, working space 6ft. by 6ft., daylight 44in., W.P. 1500 lb.

288-ton Upstroke Press, by JOHN SHAW, working space 3ft. 6in. by 2ft. 10in., daylight 1ft. 11in., Hele-Shaw pumping equipment.

220-ton Upstroke Press, working space 2ft. 6in. by 1ft. 2in., daylight 14½in., Towler pumping equipment.

Several 200-ton D/A Presses, by HYDRAULIC ENGR. CO., working space 2ft. 1in. by 2ft. 7in., daylight 36in., W.P. 4500 lb.

200-ton Horiz. Wheel Forcing Press, by JOHN SHAW, with pumping equipment.

100-ton Overhung Flanging Press, by FIELDING and PLATT, table 7ft. by 3ft. 6in.

Several unused Rams and Cyls., by JAMESON, piston type ram 15in./16in. diam. by 36in. stroke, W.P. 2240 lb.

Several unused Rams and Cyls., by FINNEY, as above, W.P. 3360 lb.

Two "Electraulic" Pumps, by TOWLER BROS., cap. 32 g.p.m. at 1200 lb., 9½ g.p.m. up to 4480 lb., motorised, 400/440/3/50.

Vert. Three-Throw Pump, by WORTHINGTON SIMPSON, cap. 25 g.p.m., W.P. 1500 lb.

Vert. Four-Throw Pump, by BRADLEY and TURTON, cap. 15 g.p.m., W.P. 2240 lb., motorised, 400/3/50.

Six-Throw Pump, cap. 10 g.p.m., W.P. 2240 lb.

Horiz. Three-Throw Pump, by SOMUA, cap. 4½ g.p.m., W.P. 5½ tons.

Two Vert. Three-Throw Pumps, by GLENFIELD and KENNEDY, cap. 4 g.p.m., W.P. 3360 lb., motorised, 400/3/50.

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POWER TRANSMISSION APPLIANCES

REDUCTION GEARS

Three 11in. by 13in. Double-Helical, Double-Reduction Gears, ratio 26 : 1, having 5in. diameter output shaft, estimated duty 130 H.P. at 1500 r.p.m., 90 H.P. at 1000 r.p.m., 75 H.P. at 750 r.p.m., input speed.

Four 10in. centres unused James Worm Reduction Gears, horizontal input shaft, vertical output shaft projecting downwards, ratio 17·66 : 1, duty 20 H.P. at 1500 r.p.m., 15 H.P. at 960 r.p.m., 12 H.P. at 720 r.p.m. input speed.

R. R. BRITTON.
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FOR SALE

SERVICE EDWARDS VALUE

HAND-GEARED Bending Roll, capacity 16ft. 8in. by 18-gauge, two front rolls 3½in. dia., back roll 4in., fitted with roller feeding device.

CRAIG and DONALD Double-Geared Plate Bending and Straightening Roll, four-roll type, capacity 62in. wide by 12-gauge, three rolls are arranged tripod fashion, with a fourth outside roller for straightening, forward and reverse motion. Weight 2 tons.

TWO Crankshafts, one giving 14½in. stroke and the other 5in. stroke. Weight 5½ tons.

DOUBLE-SIDED Blanking Press, suitable for washers, &c., single front roll feed, pressure about 45 tons, stroke of innerram 3½in., stroke of outer ram ¾in., between uprights 21½in. Weight 2½ tons.

HAND Lever Nibbling, Shearing and Rod Cutting Machine, all-steel construction, for internal and external nibbling, up to 3/16in. thick, mild steel, also cuts 3/16in. thick plate any length or width, and round bars up to ¾in.

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Single-Ended, Open-Fronted, 75-tons capacity TRIMMING PRESS, stroke 2in., direct belt drive to flywheel.

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New "WARD" 20-ton Open-Fronted, Inclinable POWER PRESSES, with 2½in. fixed stroke, motorised, 400/3/50.

New "WARD" 12-ton Ungeared End-Wheel type POWER PRESSES, with adjustable stroke, motorised, 400/3/50.

New "HEDLEY" 12½-ton Open-Fronted, Inclinable, Ungeared POWER PRESSES, with adjustable stroke, motorised, 400/3/50.

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"EDWARDS" No. 21, 40 tons capacity POWER PRESSES, fixed stroke 2in., motorised, 400/3/50.

"BUFFALO" Steel-Plate Frame Combination PUNCHING, PLATE SLITTING and ANGLE CROPPING MACHINE, shear 6in. by ¼in. plates, punch 1¼in. through 1¼in., crop 3½in. rounds, 3½in. squares, motor driven with 25 H.P. motor for 220 volts D.C. supply.

THOS. W. WARD LTD.

ALBION WORKS - - - SHEFFIELD.
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MACHINE TOOLS

CINCINNATI 36in. Openside Planing M/C, table working surface 60in. by 17in., motorised, 400/3/50.

ALBA Model "6s" 24in. stroke Crank Shaper, 20in. by 12in. slotted box work table, automatic feeds, motorised, 400/3/50.

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ARCHDALE 30in. Plain Horiz. Miller, table working surface 48in. by 13in., self-contained motor drive, 400/3/50.

NOBLE and LUND Circular Saw Sharpening M/C for metal cutting saw blades, reciprocating grinding wheel type, max. diam. 42in. saws or with pit 60in., motorised, 400/3/50.

TURNER 1¼in. cap. Capstan, arranged for bar work, twelve spindle speeds by pick-off gears, motorised, 400/3/50.

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NOBLE and LUND 40in. Metal Cutting Bandsaw, 40in. diam. wheels, 41in. throat, auto. feed to tables 21in. by 42in., motorised, 400/3/50.

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For continuation of Small Advts., page 6

FOR SALE

PUMP UNITS

NEW ELECTRICALLY-DRIVEN CENTRIFUGAL PUMPING SETS

UNITS UP TO 100FT. HEAD.

65 g.p.m./50ft. head, 2in. single-stage Pump, type CF200, direct coupled on bed-plate to 2 H.P. S.C., 1425 r.p.m. motor, 400/440/3/50.

90 g.p.m./30ft. head, 2in. single-stage Pump, by Pulsometer, type K2, direct coupled on bed-plate to 1½ H.P. S.C., 1425 r.p.m. motor, 400/440/3/50.

125 g.p.m./90ft. head, 1½in. single-stage Pump, by Pulsometer, type LEX-1½, direct coupled on bed-plate to 7½ H.P. S.C., 1440 r.p.m. motor, 400/440/3/50 or 500/550/3/50.

175 g.p.m./88ft. head, 2in. single-stage Pump, by Pulsometer, type LEX-2, direct coupled on bed-plate to 10 H.P. S.C., 1440 r.p.m. motor, 400,440/3/50 or 500/550/3/50.

200 g.p.m./50ft. head, 4in. self-priming, single-stage Pump, by Pulsometer, type KPX-4, direct coupled on bed-plate to 7½ H.P. S.C., 1440 r.p.m. motor, 400/440/3/50 or 500/550/3/50.

250 g.p.m./40ft. head, 3in. single-stage Pump, type CF310, direct coupled on bed-plate to 7½ H.P. S.C., 1440 r.p.m. motor, 400/440/3/50 or 500/550/3/50.

325 g.p.m./100ft. head, 3in. single-stage Pump, by Pulsometer, type LEX-3, direct coupled on bed-plate to 15 H.P. S.C., 1450 r.p.m. motor, 400/440/3/50 or 500/550/3/50.

400 g.p.m./43ft. head, 4in. single-stage Pump, by Pulsometer, type A4, direct coupled on bed-plate to 10 H.P. S.C., 1440 r.p.m. motor, 400/440/3/50 or 500/550/3/50.

450 g.p.m./27ft. head, 4in. single-stage Pump, type CF410, direct coupled on bed-plate to 10 H.P. S.C., 1440 r.p.m. motor, 400/440/3/50 or 500/550/3/50.

600 g.p.m./35ft. head, 5in. single-stage Pump, by Pulsometer, type K5, direct coupled on bed-plate to 15 H.P. S.C., 1450 r.p.m. motor, 400/440/3/50 or 500/550/3/50.

750 g.p.m./100ft. head, 4in. single-stage Pump, by Pulsometer, type LEX-4, direct coupled on bed-plate to 40 H.P. S.C., 1450 r.p.m. motor, 500/550/3/50.

800 g.p.m./70ft. head, 5in. single-stage Pump, by Pulsometer, type LEX-5, direct coupled on bed-plate to 28 H.P. S.C., 965 r.p.m. motor, 400/440/3/50.

UNITS OVER 100FT. HEAD.

14 g.p.m./300ft. head, 1½in. two-stage, self-priming Pump, by G.G.G., type 125 BS, direct coupled on bed-plate to 5 H.P. S.C. motor, 2900 r.p.m., 400/440/3/50.

50 g.p.m./430ft. head, 1½in. Turbine Pump, by Gwynne, type P1½/6, direct coupled on bed-plate to 5 H.P. S.C. motor, 2900 r.p.m., 400/440/3/50 or 500/550/3/50.

60 g.p.m./140ft. head, 1½in. single-stage Pump, by Pulsometer, type BEMX-1½, direct coupled on bed-plate to 5 H.P. S.C. motor, 2900 r.p.m., 400/440/3/50.

80 g.p.m./150ft. head, 2in. two-stage Pump, by Pulsometer, type HSRB-2, direct coupled on bed-plate to 7½ H.P. S.C. motor, 1440 r.p.m., 400/440/3/50 or 500/550/3/50.

110 g.p.m./400ft. head, 1½in. two-stage Pump, by Pulsometer, type HSRB-1½, direct coupled on bed-plate to 30 H.P. S.C. motor, 2900 r.p.m. 400/440/3/50 or 500/550/3/50.

125 g.p.m./400ft. head, 2in. Turbine Pump, by Gwynne, type P2/4, direct coupled on bed-plate to 30 H.P. S.C. motor, 2900 r.p.m., 400/440/3/50 or 500/550/3/50.

175 g.p.m./480ft. head, 4in. two-stage Pump, by Mather and Platt, type 4in./6in. CH Pluro, direct coupled on bed-plate to 70 H.P. S.C. motor, 2950 r.p.m., 400/440/3/50.

250 g.p.m./175ft. head, 3in. two-stage Pump, by Pulsometer, type HSRB-3, direct coupled on bed-plate to 25 H.P. S.C. motor, 1450 r.p.m., 400/440/3/50 or 500/550/3/50.

350 g.p.m./185ft. head, 4in. two-stage Pump, by Pulsometer, type HSRB-4, direct coupled on bed-plate to 30 H.P. S.C. motor, 1450 r.p.m., 400/440/3/50 or 500/550/3/50.

400 g.p.m./150ft. head, 4in. single-stage Pump, by Pulsometer, type LEX-4, direct coupled on bed-plate to 30 H.P. S.C. motor, 1450 r.p.m., 400/440/3/50 or 500/550/3/50.

500 g.p.m./420ft. head, 6in. Turbine Pump, by Pulsometer, type TG4/6, direct coupled on bed-plate to 100 H.P. S.C. motor, 1460 r.p.m., 500/550/3/50.

600 g.p.m./150ft. head, 5in. two-stage Pump, by Pulsometer, type HSRB-5, direct coupled on bed-plate to 50 H.P. S.C. motor, 1460 r.p.m., 400/440/3/50.

750 g.p.m./118ft. head, 5in. single-stage Pump, by Pulsometer, type LEX-5, direct coupled on bed-plate to 45 H.P. S.C. motor, 1460 r.p.m., 400/440/3/50.

NEW DIESEL-DRIVEN CENTRIFUGAL PUMPING SETS

150 g.p.m./110ft. head, 3in. single-stage Pump, by Pulsometer, type LEX-3, direct coupled on bed-plate to 1-VSH Ruston Hornsby diesel.

400 g.p.m./90ft. head, 4in. single-stage Pump, by Pulsometer, type LEX-4, direct coupled on bed-plate to 2-VSH Ruston Hornsby diesel.

ENQUIRY DETAILS.

With enquiries, kindly furnish the following data :—Estimated quantity and total head in feet if water or other liquid. Re motor : type of enclosure preferred.

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OIL-OPERATED REVERSING and REVERSE-REDUCTION GEARBOXES

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FOR DISPOSAL, EX STOCK.

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300-kW. Alternator, by Mather and Platt, Ltd., 6000/6600 volts, three-phase, 50 cycles, 1000 r.p.m., 0.8 power factor, direct-coupled exciter ; a 400 H.P. Paxman diesel engine can be supplied with this unit, also a 400kVA., 6500/443 volts, three-phase, 50 cycles transformer.

20-kVA. Petrol-driven Alternator Set, comprising four-cylinder, hand-starting petrol engine, by Coventry Climax Engines, Ltd., mounted on fabricated channel base and direct coupled to a 20-kVA., 230-volt, single-phase, 50 cycles, 1500 r.p.m. alternator, by Metro-Vick, complete with direct-coupled exciter and instrument panel ; ideal for factory or office lighting.

9-kVA. Petrol-driven Alternator Set, comprising four-cylinder, hand-starting petrol engine, by Meadows, mounted on fabricated steel base plate and direct coupled to a 9-kVA., 230 volts, single-phase, 50 cycles, 1500 r.p.m. Alternator, by B.T.H., complete with belt-driven exciter and regulator ; ideal for office lighting. These sets will carry eighty 100-watt gas-filled lamps or seventy-eight 80-watt fluorescent lamps ; twenty available.

GENERATORS.

75-kW. Diesel Generating Set, comprising 75-kW., 220-volt D.C. generator, by G.E.C., mounted on cast iron base and direct coupled to a 100 H.P. Cummins six-cylinder, vertical diesel engine, complete with instrument panel.

30-kW. Diesel Generating Set, comprising 44 H.P., four-cylinder, diesel engine, by Davey Paxman and Co., Ltd., type 4 RQ, speed 1100 r.p.m., mounted on fabricated channel base plate and direct coupled to a 110-volt D.C. generator, by W. H. Allen and Co., Ltd.

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E6176 G

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SPECIAL PLANT

Two Evaporating and Distilling Plants, by G. and J. WEIR, new 1945, cap. 100 tons each, fresh water from salt water in 24 hrs., evaporators 6ft. 9in. high by 30in. diam., 10 banks copper steam coils secured in C.I. header easily removed by opening inspection doors (spare coils available), each unit complete with distiller condenser 2ft. diam. by 4ft. 10in., cooler condenser 9in. diam. by 4ft. 10in., one evaporating reciprocating-steam-driven combination pump dealing with feed discharge and vacuum, and one steam-driven reciprocating circulating water pump ; interconnecting piping not included.

Complete Distilled Water Plant, comprising six steam-heated Manesty stills, type No. 4, 50 gallons per hr. each, one automatic loading tank, two direct-motor-driven rotary pumps, vert., pressure storage tank of welded construction, suitably lagged, approx. 11ft. deep by 5ft. 6in. diam., with raised manhole 2ft. diam., with eighteen 1in. diam. swing bolts for securing ; unit complete with all connecting piping, valves, &c.

8in. Rotary Vacuum Pump, by GENERAL ENGINEERING CO., of Ratcliffe, size AV. 110 G, cap. 1126 cu. ft. per min., at 23in. vacuum, machine No. 1357, direct coupled by flexible coupling to a 45 b.h.p. motor, by Laurence Scott, 400/3/50, 585 r.p.m., with A.E.C. starter and isolator, automatic control panel giving visual indication ; unit complete with Foxborough control valve, gauges and connecting piping.

Two direct electrically under-driven Hydro-Extractors, by THOS. BROADBENT, three-point suspension, pit type, with 72in. diam. galvanised perforated basket, hand-operated brake, motorised, 400/3/50.

Three complete unused Suction Gas Producer Plants, by DAWSON and MASON GAS PLANT CO., Manchester, each having cap. 30,000 cu. ft. per hr.

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MELMAG PRODUCTIONS.
STEEL SECTIONS.—Angles, Tees, Joists, Bars, Flats, Rounds, Sheets, Pipes. See our last week's advert.
NISSEN BUILDINGS.—Guaranteed. Ready for erection, 100 thoroughly reconditioned, 16ft. wide, unlined, 18ft. long, £24 ; extra 6ft. lengths, £7 ; ends, £6 each. Immediate delivery, carriage paid 100 miles ; 24ft. widths also available.
STEEL-FRAMED BUILDINGS.—Wide range, easily erected, widths 8ft. to 30ft., any length.
STEEL ROOF PRINCIPALS.—Various widths, complete with or without purlins.
Stock List and Catalogue on request.
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E6191 G

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(Established 25 Years)
OFFER FOR SALE :—
100 Tons of Dorman Long KIII Section STEEL PILING, in 36in. lengths, including four corners ; the clutches are split to facilitate driving. Has only been driven once. In very good condition.
ONE 10-Ton Henderson STEAM DERRICK CRANE, 120ft. jib, complete with bogies. New 1944.
ONE Sykes 7-Ton Steam-Driven, Double-Drum PILING WINCH, 8ft. 6in. by 3ft. diameter. Cross-tube boiler (equivalent to a No. 8 Spencer Hopwood boiler), completely reconditioned as new.
ONE 7-Ton Butters STEAM DERRICK CRANE, 100ft. jib.
ONE 10-Ton Smith STEAM LOCO. CRANE, 40ft. lattice jib, 4ft. 8½in. gauge.
5-Ton Smith STEAM LOCO. CRANE, 35ft. jib, 4ft. 8½in. gauge.
Bagnall 0-4-0 LOCO., 12in. cylinders, 4ft. 8½in. gauge, completely overhauled.
Fowler Diesel-Driven LOCO., 80 B.H.P., 0-4-0, 4ft. 8½in. gauge, first-class working order.
Agents for "Morgan" Derrick Cranes.
Agents for "Weaver" Steam Cleaners, indispensable for degreasing, cleaning, and paint stripping. Ideal for all contractors' plant. Details on request.
Further details, 14, Lower Grosvenor Place, S.W.1.
PLEASE NOTE NEW TELEPHONE NO.: VICtoria 7531, 3501, 8080 (11 lines). E218 G

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LOCOMOTIVES

Several unused 2ft. gauge RUSTON Diesel Locomotives, 2½ tons model, driven by 16/20 h.p. Ruston engines, type 2 VSO, fitted with three gears in either direction. All for immediate delivery at low prices.
HUNSLET 0-6-0 Steam Locomotive, 12in. by 18in. cyls., wheel base 9ft. 6in., 4ft. 8½in. gauge.
HUDSWELL-CLARKE 0-6-0 Steam Locomotive, 12in. by 18in. cyls., wheel base 10ft. 6in., 4ft. 8½in. gauge.
SENTINEL 0-4-0 Steam Locomotive, wheel base 5ft., 4ft. 8½in. gauge.

GEORGE COHEN,
SONS AND CO. LTD.
WOOD LANE, LONDON, W.12.
Tel.: Shepherds Bush 2070 ; and
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Tel.: Pudsey 2241. E200 G

For continuation of Small Advts., page 134

FOR SALE

OFFERED FROM OUR STOCKS.
HORIZONTAL AND VERTICAL BORERS
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8in. RICHARDS Model H. ... motor drive, table 24in. by 39in., ... speed range 29.9-750 r.p.m.
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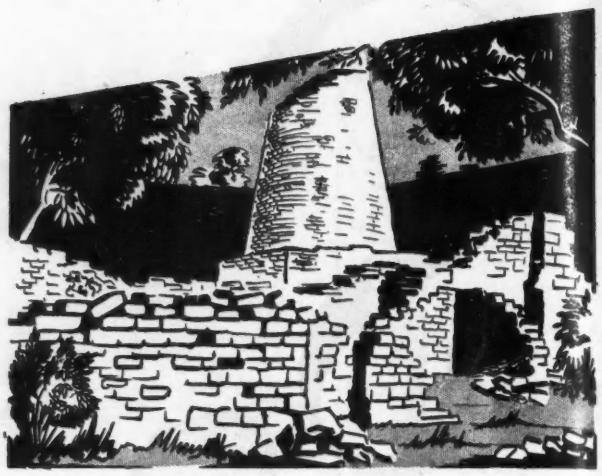
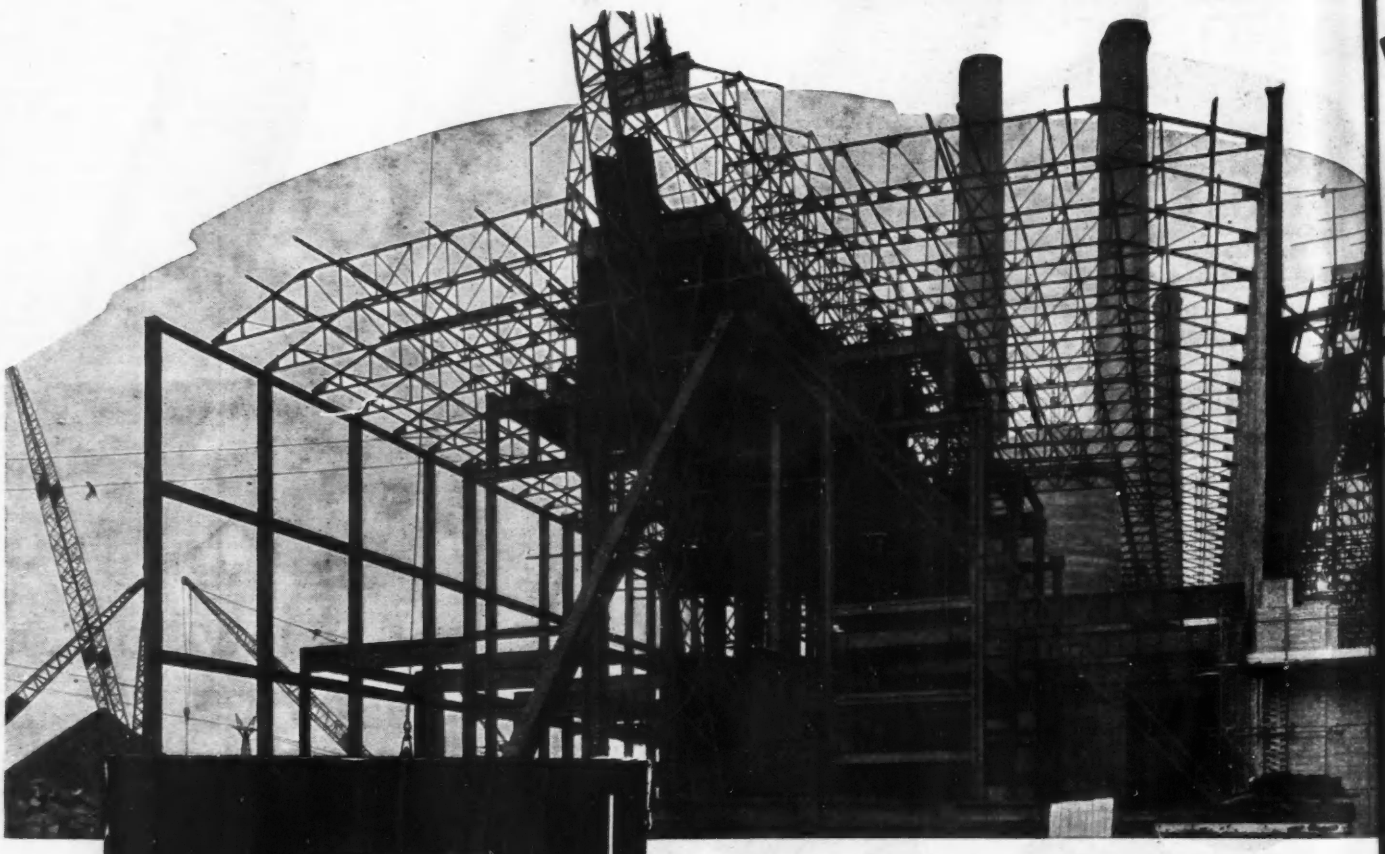
The ruins of Zimbabwe remain shrouded in mystery, the more so because the exellence of the building indicates an advanced civilisation of which all trace has been lost.





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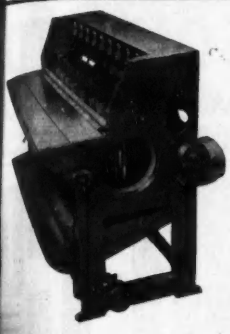

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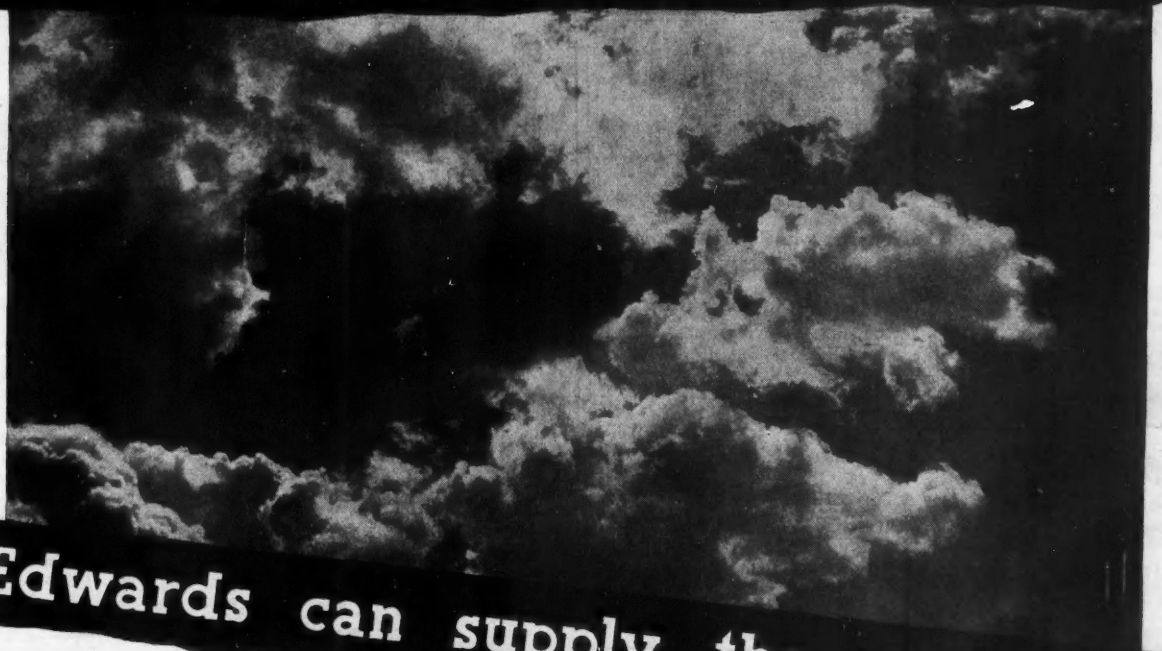

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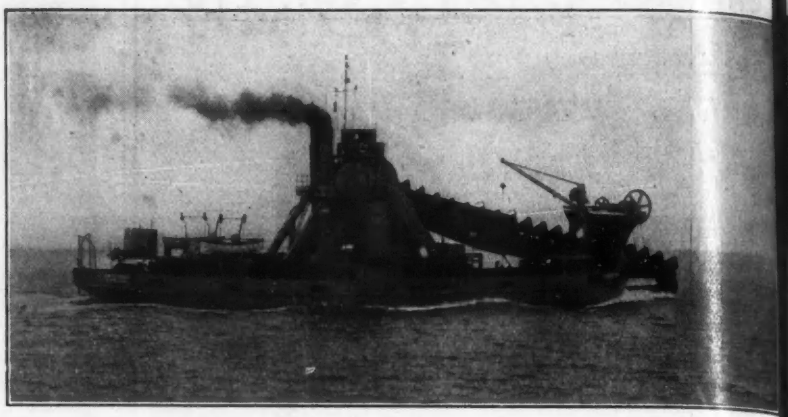

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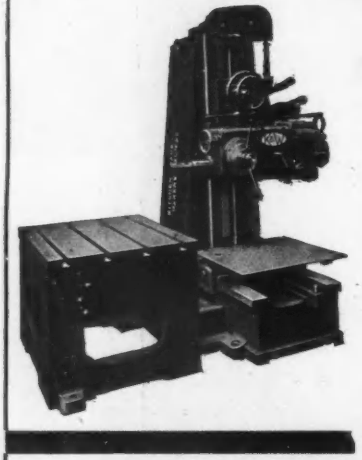

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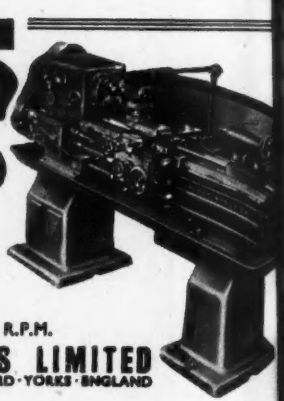

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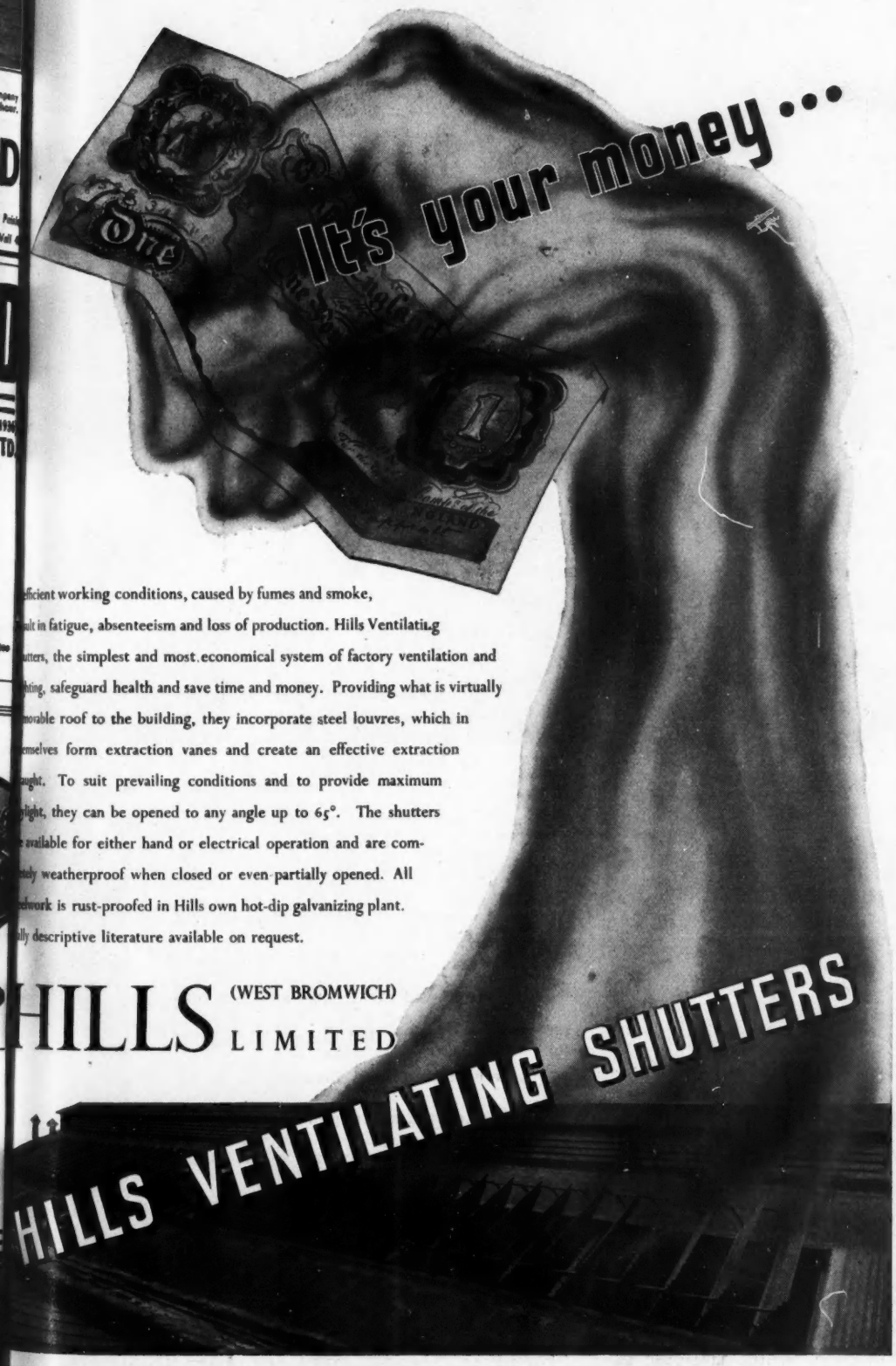

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EP 18

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6 SIZES :—
50 lbs. to 12,500 lbs.
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DELIVERIES :—
2–12 MONTHS
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Grinds, dries and delivers in one operation :—

COAL, CHALK, LIMESTONE, CHINA CLAY, BALL CLAY, SEWAGE SLUDGE and other materials.

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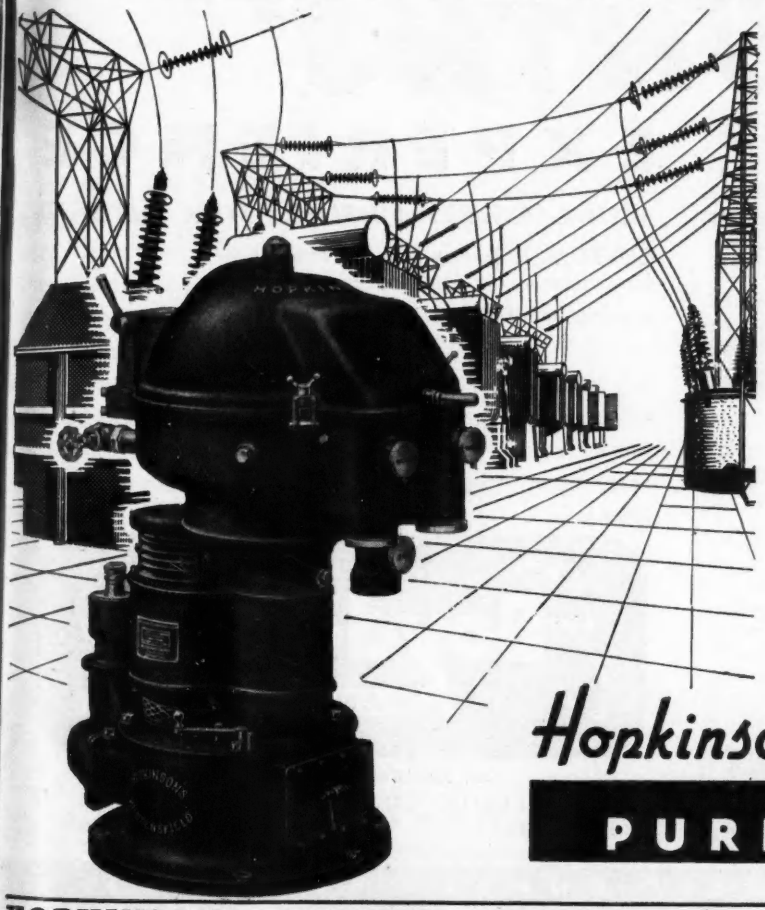

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For the purification of insulating, lubricating and cutting oils, and the clarification of industrial liquids.

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Petrol (gallons)	1783
Oil changes (gallons)	43
1 spare part (cost)	£12.14.2.
Total time lost	5 hours

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16 mm. Film Projectors.

How **HOOVER LTD.** *use a G.B.-Bell & Howell Film Projector.*

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(Illustrated.) The G.B.-Bell & Howell 16 mm. Sound Film Projector Model 601. Projects black-and-white and full colour films with true-tone reproduction of image and sound. No 'flutter'; interference eliminator; auto-lubricating; fast rewind; public address system. Lifetime service and guarantee. Other models available for rooms, halls, auditoriums, etc., of any size.

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A Company within the J. Arthur Rank Organisation

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We are interested in G.B.-Bell & Howell 16 mm. Film Projectors:
Please send full details of all available models.
Please arrange a demonstration at the address given.
Please send Catalogue of G.B. Films and details of G.B. Industrial Film Distribution Service.
Delete lines not applicable.

Company's Name.....
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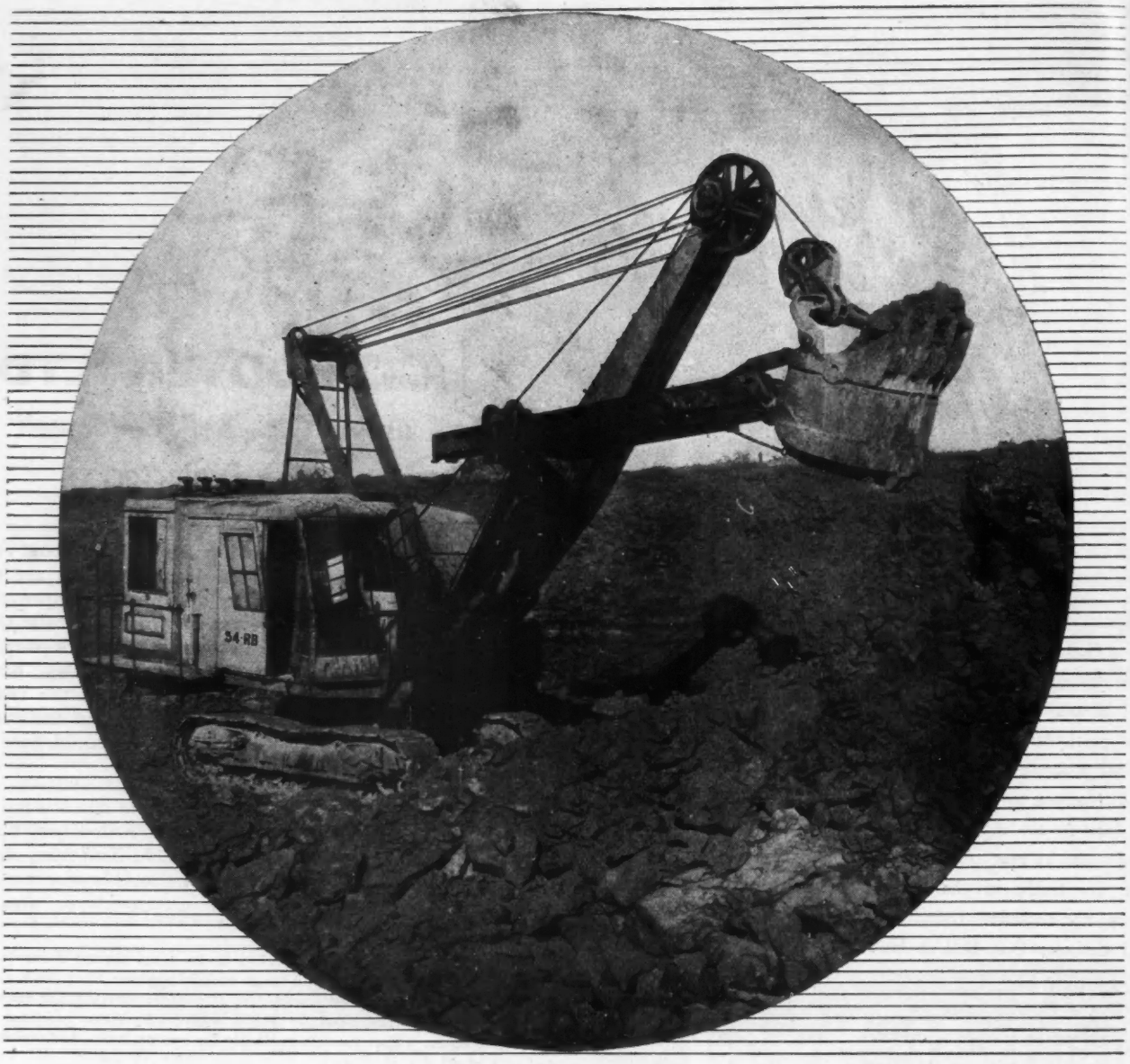
12/2A

EXCAVATORS—

R B FOR PREFERENCE



The 54-RB 2½ cubic yard shovel shown here loading ironstone can also be supplied as a dragline and with diesel or electric power. The Ruston-Bucyrus standard range is from ⅜ to 5 cubic yards capacity, but whatever the work, it's "R-B for preference!"

RUSTON-BUCYRUS

RUSTON-BUCYRUS LTD., EXCAVATOR SPECIALISTS, LINCOLN

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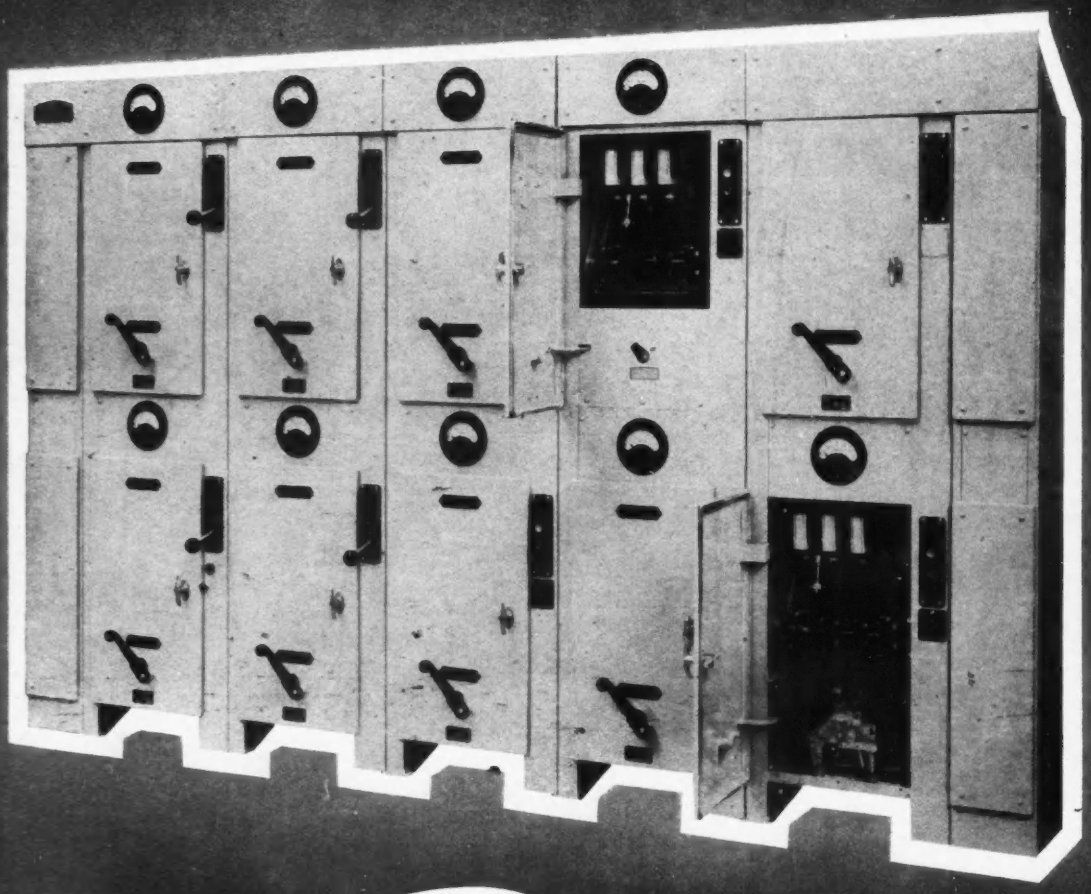
Pouring alloy steel from an electric arc furnace.

RICHARD THOMAS & BALDWINS LIMITED

distribution and motor control gear



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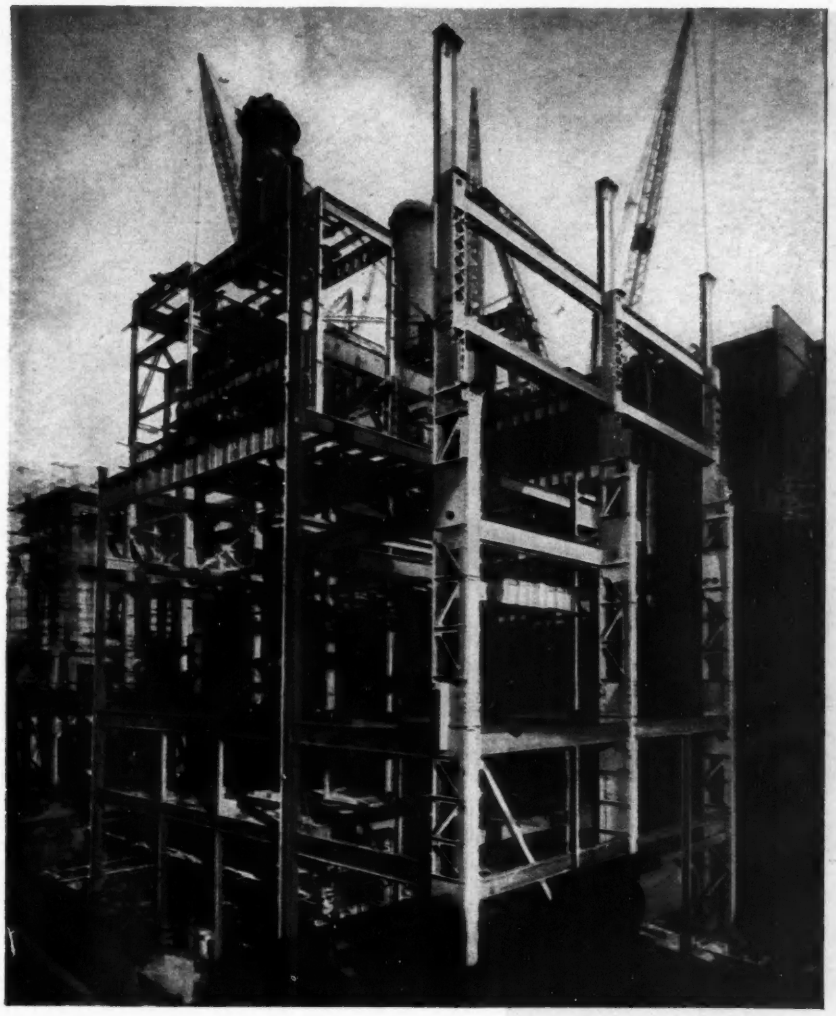

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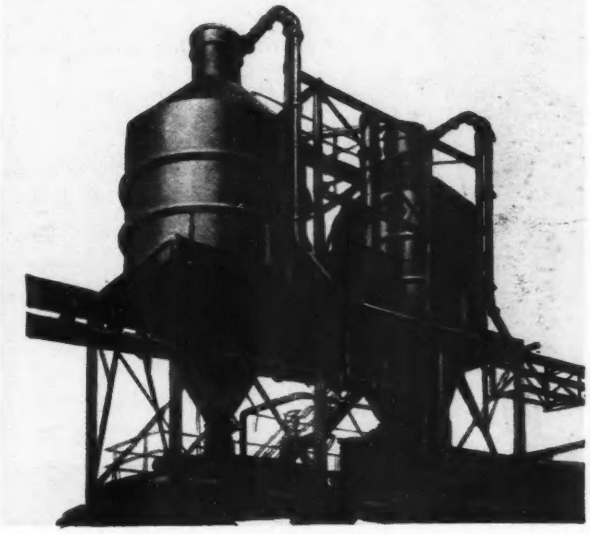
Whenever heavy loads have to be carried by compact structural elements of unquestioned security, steelwork is practically universal. The illustration shows part of an extension to a power station, the three large stanchions are for the turbine house, with annexe, workshop and boiler house behind.

Right, the cyclones for the power station completed by welding on site, — another example of the versatility of steelwork economy in reducing transport and other costs.



BRITISH CONSTRUCTIONAL STEELWORK ASSOCIATION
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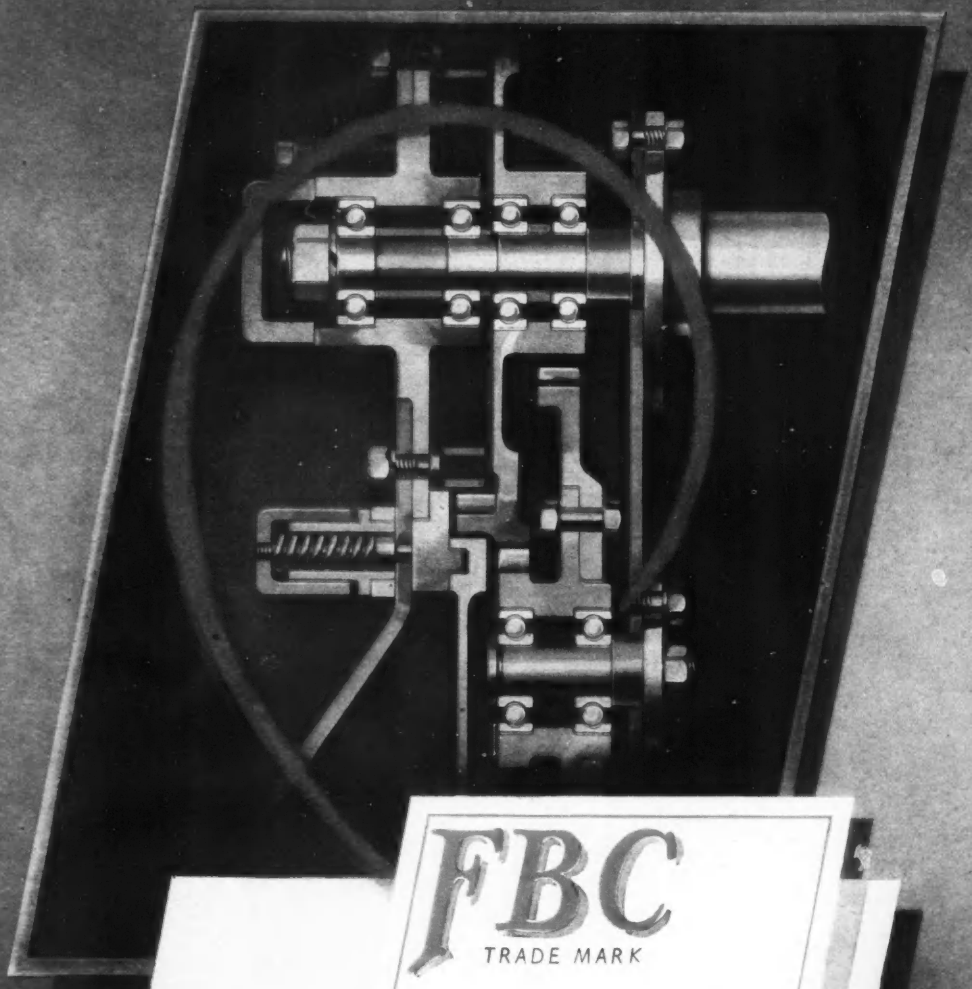
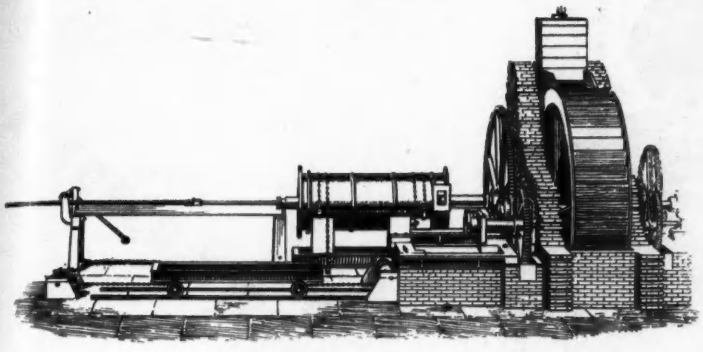


FBC
TRADE MARK

All - British ball and parallel - roller bearings for every purpose.

The illustration shows some of the F.B.C. deep-groove bearings on a gang mower made by Thomas Green & Son, Ltd.

FISCHER BEARINGS CO. LTD., WOLVERHAMPTON
Subsidiary of British Timken Ltd.
Works: Birmingham, and Duston Northampton



1775

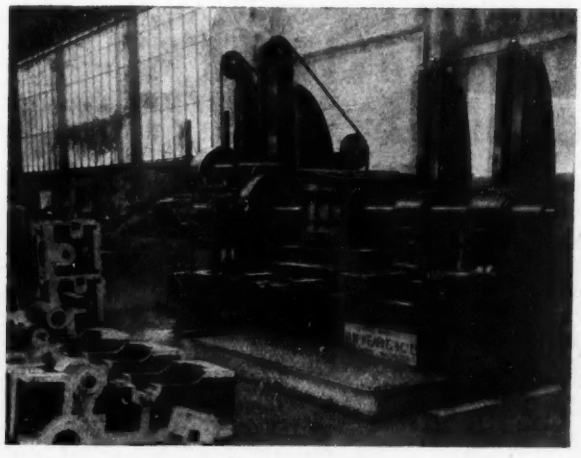
John Wilkinson's horizontal borer was also the first machine tool. Designed to bore cannon accurately, it insured the commercial success of Watt's steam engine.

Illustration by courtesy of The Science Museum.

KEARNS

biography of the borer

WATT "WRAPPED IT (*the piston*) around with cork, oiled rags, tow, old hats, paper and other things, but still there were open spaces left, sufficient to let the air in and the steam out." The main fault lay in the cylinder bore where, as he complained, "at the worst place the long diameter exceeded the short by three-eighths of an inch." Fortunately, John Wilkinson detected what had escaped Watt and Smeaton concerning the latter's boring machine and, in 1775, made the boring bar heavier, extended it to pass right through the cylinder and gave it fixed support at the outboard end. Prompt reduction of boring errors to less than one-sixteenth of an inch on large diameters proved the correctness of the principle that remains basic to-day . . . solid support of the boring bar.



Kearns for Borers

Using two boring stays to gain maximum boring bar rigidity under heavy cutting on a locomotive cylinder. No. 4 Patent Horizontal Surfacing and Boring Machine.

H. W. KEARNS & CO. LIMITED Broadheath near Manchester

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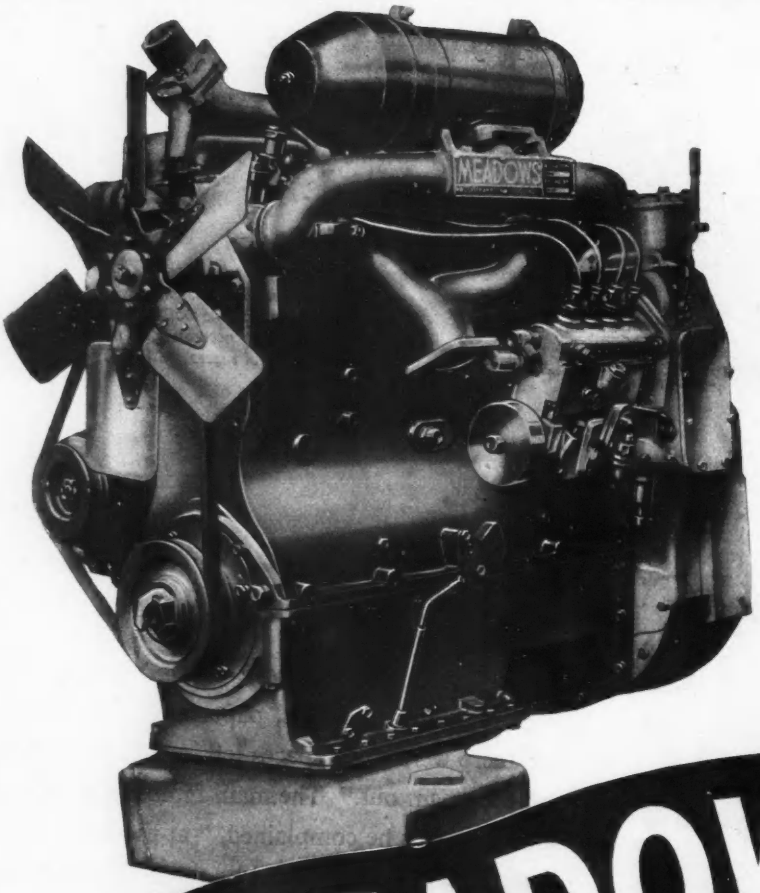

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80 HP OIL ENGINE ... at 2,200 r.p.m.

lowest-cost high-specification 4 cylinder direct injection

6 cyl. smoothness: harmonic balancers
Low fuel consumption: .370 lbs/h.p./hour
Low piston speed: square bore/stroke ratio
High power/weight ratio
Shortest 80h.p. oil engine: overall length 35.47ins.

Illustrated folder on request

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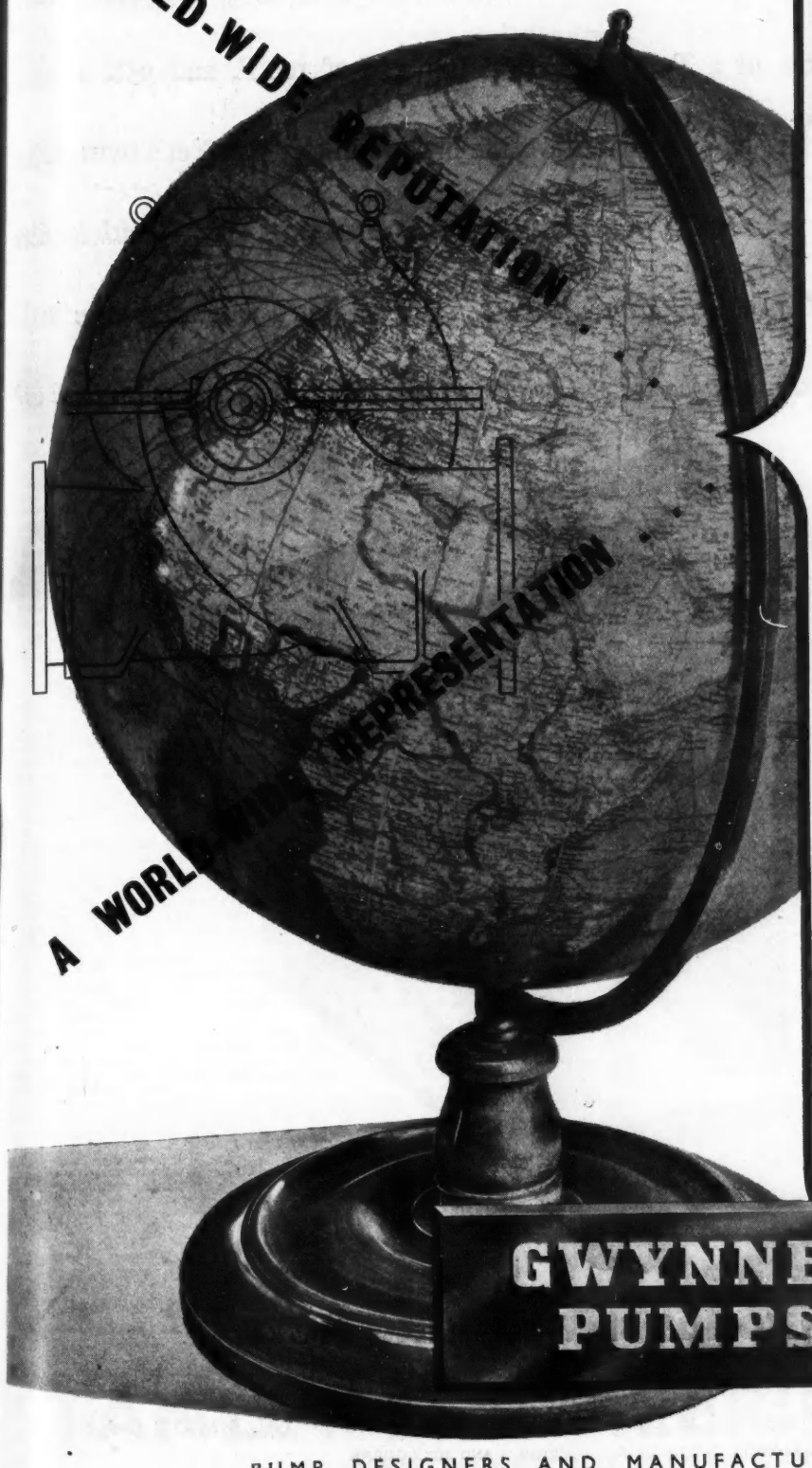

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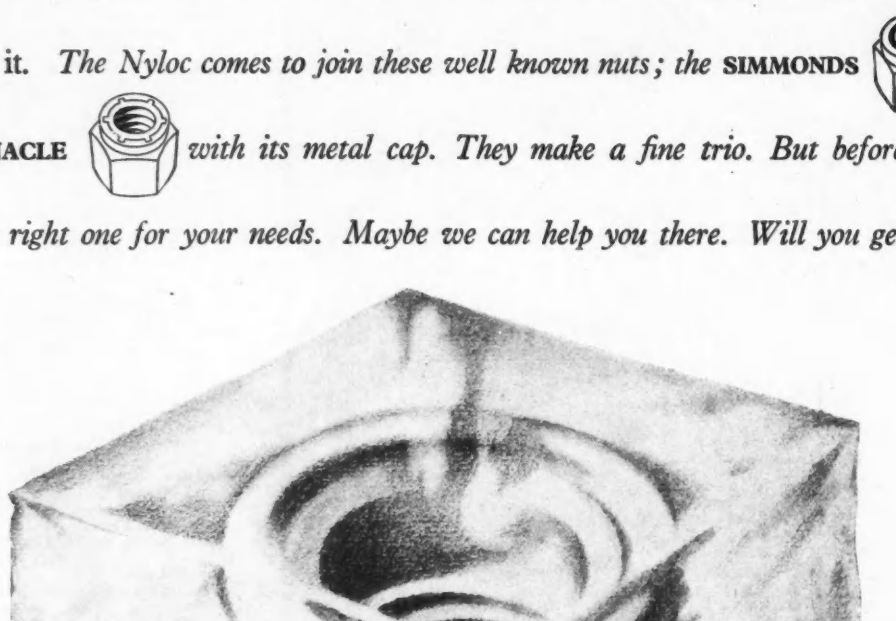

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TWO UNUSED ALL-STEEL HAND-OPERATED SELF SUSTAINING DERRICK CRANES, by Butters Bros., Glasgow; 2½-ton capacity, with full slewing and derricking jib, 14ft. long, single and double purchase.

ONE SECOND-HAND 2-TON PORTABLE HAND ROAD CRANE, by STANDARD STEEL CO., CROYDON, having fixed jib, 15ft. long, on four road wheels, with swivelling carriage and draw-bar, hand brake, with movable ballast box, full-circle slewing.

TWO 5-TON CAPACITY TREBLE-PURCHASE, HAND-OPERATED WINCHES, by "Ritchie-Atlas," having winding barrels 30in. by 12in. dia.; depth of flanges 6in.; constructed of steel side plates; with hand brake, ratchet and pawl.

ONE "BRITISH THOMSON-HOUSTON" 1-TON ELECTRIC LIFTING HOIST, for 500 volts, direct current.

NEW 15-CWT. and 10-CWT. ALL-STEEL SIDED FRICTION HOIST, for belt, electric or engine drive; complete sets made up.

TWO ELECTRICALLY OPERATED HOISTS, by Metropolitan-Vickers, 1-ton capacity at 300ft. per minute lifting speed, 220 volts D.C., with reversing controller and built-in resistances.

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ONE ELECTRICALLY OPERATED PUMPING SET, comprising a "Pulsometer" Turbine Pump, having 2½in. suction and delivery branches; capable of a duty of 67/75 g.p.m. against 249/235ft. head; Refiux valve fitted; direct coupled to a 10 H.P. Squirrel-Cage Motor, by "E.E.C.," 400 volts, three-phase, 50 cycles, 1440 r.p.m.; all mounted on cast iron bed-plate; complete with starter.

ONE "MATHER and PLATT" 5/4in. TWELVE-STAGE CENTRIFUGAL PUMP, 4in., 12 C.H. Pluro, 215 g.p.m. at 4620ft. head at 3430 r.p.m. with Sturtegear, 550 H.P. increasing gearbox, by K. Shaw, or, alternatively, 10,500 g.p.h at 750ft. head at 1500 r.p.m., absorbing 75 H.P.

TWO CENTRIFUGAL PUMPS, by "Sulzer," 6in. suction and 5in. delivery, 500 g.p.m. against 100 lb. working pressure, driven by 55 H.P. "Ford" V.8 petrol engines.

ONE CENTRIFUGAL PUMP by "Lee Howl," with 2in. suction and delivery; vee rope driven by a "National" Vertical, Single-Cylinder Diesel Engine.

ONE VERTICAL GEARED TREBLE-RAM PUMP by "Hayward Tyler," 3¼in. dia. by 4½in. stroke, 2½in. suction and delivery, 2000 g.p.h. at 300ft. head, driven by a 10 H.P. Vertical Diesel Engine.

TWO UNUSED PORTABLE "NOVO" LIFT and FORCE DIAPHRAGM PUMPS, with 4in. suction and delivery, 6000 g p h. against 10ft. static lift, driven by a "Wisconsin" Air-Cooled Petrol Engine; on bed-plate with two road wheels and barrow type handle.

ONE VERTICAL GEARED TREBLE-RAM PUMP, by "Pearn," 4½in. dia. by 6in. stroke, 4in. suction and 3in. delivery, 4000 g.p.h. at 350ft. head, vee rope driven by "Meadows" Vertical Petrol Engine.

ONE CENTRIFUGAL PUMP, by "Pulsometer," type HSRB.2, split carcase, 3in. suction and 2in. delivery, 42 g.p.m. at 157ft. head, driven by a "Coborn" type C.2 Air-Cooled Petrol Engine.

TWO VERTICAL FLEXHEAD PUMPS, by "Stothert and Pitt," 2in. suction and delivery, capacity about 2 tons of lubricating oil (about 2000 viscosity) per hour at 15 lb. pressure, driven by 1 H.P. Compound-Wound D.C. Motors; complete with starters.

TWO VERTICAL-SPINDLE TYPE "STEREOPHAGUS" PUMPS, by "Pulsometer," 4in. suction and delivery, 300/488 g.p.m. at 80/60ft. head, driven by 20 H.P. "Crompton-Parkinson" protected type Slip-Ring Motors.

ONE UNUSED CENTRIFUGAL ACID PUMP, by "Mitchell of Manchester," type MS.5/160, pump body porcelain-lined with vitreous impeller, 2½in. suction and 2in. delivery, 1500 g.p.h. against 50 lb. working pressure.

ONE HYDRAULIC RAM PUMP, by the "Hydraulic Engineering Co.," output 17 g.p.m. against 500 lb. pressure, or 3·3 g.p.m. against 2 tons pressure; driven by 13 H.P. "Crompton-Parkinson" A.C Motor.

TWO VERTICAL GEARED TREBLE-RAM PUMPS, by "Hayward Tyler," 4in. suction, 3in. delivery, 32,000 g.p.h. at 120ft. head.

ONE VERTICAL TREBLE RAM PUMP, by "Lee Howl," 4in. suction and 3in. delivery, 4000 g.p.h. at 350ft. head; vee belt driven by a "Meadows" Vertical Four-Cylinder, Radiator-Cooled Petrol Engine.

ONE CENTRIFUGAL PUMP, by "Mather and Platt," 4in., 3 C.H. Pluro, with 6in. suction and 4in. delivery; about 10 000 g.p.h. at 350ft. head at 2250 r.p.m.; direct coupled to "Ford" V.8 Petrol Engine (can be separated).

FIVE UNUSED VERTICAL GEARED TREBLE-RAM PUMPS, by "Joseph Evans," 4in. dia. by 6in. stroke, 2½in. suction and delivery, 1950 g.p.h. at 350ft. head; driven by "Novo" Radiator-Cooled Petrol Engines.

ONE FIVE-STAGE CENTRIFUGAL TURBINE PUMP, by "Gwynne" 2in. suction and delivery, 100 g.p.m. at 60ft. head, or 30 g.p.m. at 130ft. head at 1470 r.p.m.; vee belt driven by an 18 H.P. "Pelapone" Diesel Engine.

FIVE UNUSED DOUBLE-ACTING PISTON PUMPS, by "Lee Howl," 1¼in. by 2in. stroke, 1½in. suction and delivery, 200 g.p.h. at 250ft. head; vee belt driven by 1½ H.P. "Wolseley" Petrol Engines.

ONE CENTRIFUGAL PUMP, by "Mather and Platt," type 2.6 CH. Pluro, with 2in. suction and delivery, 50 g.p.m. at 250ft. head at 1800 r.p.m.; driven by an 8 H.P. "Ford" Petrol Engine.

ONE CENTRIFUGAL PUMP, by "Pulsometer," 2in. suction, 1½in. delivery, 2500 g.p.h. at 155ft. head; driven by 3 H.P. "Coborn" Air-Cooled Petrol Engine.

ONE SPLIT CARCASE CENTRIFUGAL PUMP, by "Pulsometer," type HSM.2, 3in. suction, 2in. delivery, 3000 g.p.h. at 70ft. head; driven by a 3 H.P. "Petter" Air-Cooled Petrol Engine.

TEN UNUSED FIVE-STAGE CENTRIFUGAL PUMPS, by "Gwynne," 2in. suction, 1½in. delivery, 3000 g.p.h. at 250ft head; driven by 8 H.P. "Ford" V.8 Petrol Engines.

ONE ALL-CAST-IRON CENTRIFUGAL PUMP, by "Dryadale," with 4in. suction and delivery; driven by a 7½ H.P. Squirrel-Cage Induction Motor, by "E.E.C.," 400/3/50.

TWO CENTRIFUGAL PUMPS, by "Pearn," Series A, 2in suction and 1½in. delivery, 1000 g.p.h. at 40ft. head; driven by a 2 H.P. Squirrel-Cage Motor, by "Crompton-Parkinson," 400/3/50; complete with starters.

ONE "MONO" PUMP, type D6D, with 2in. suction and delivery, screwed connections; vee belt driven by 5 H.P. Squirrel-Cage Motor, by Hugh Scott and Co. (Belfast), Ltd., 400/440/3/50.

ONE HORIZONTAL STEAM-DRIVEN DUPLEX PUMP, by "Worthington Simpson," size 16in. by 8½in by 10in., 6in. suction and 5in. delivery; steam inlet 2½in., 4in. exhaust, 10,900 g.p.h. at 150 lb. working pressure.

ONE STEAM DRIVEN DUPLEX BALLAST PUMP, by "Tangye," size 8in. by 8in. by 10in., 7in. suction and 6in delivery, 19,000 g.p.h. on general service.

FIVE HORIZONTAL STEAM-DRIVEN TANDEM PUMPS, by "Dawson and Downie," 4in. by 4in. by 1½in. by 6in. stroke; steam pressure 100 lb. per square inch, circulating pump capacity 1650 g.p.m., discharge pressure 19 lb. per square inch, feed pump capacity 120 g.p.h., discharge pressures 50 lb. per square inch; with various fittings.

ONE RECONDITIONED "WORTHINGTON SIMPSON" HORIZONTAL DUPLEX PISTON PUMP, 6in dia. steam cylinder by 4in water cylinder by 6in. stroke; water end brass lined and brass piston-rods, 3in. suction and 2in. delivery outlet; 11in steam inlet, 1½in. boiler exhaust; complete with drain cocks, but no companion flanges; suitable for at least 70/100 lb. working pressure.

ONE NEW "WEIR" BOILER FEED PUMP, size 2½in. by 3½in. by 5in., capacity 340 g.p.h. at 25/100 lb. per square inch.

DIESEL ENGINES

FOUR RECONDITIONED "FOWLER" VERTICAL, TWIN-CYLINDER, HEAVY-DUTY, COLD-STARTING DIESEL ENGINES, 16 H.P., type 2.DH., 1500 r.p.m., with single flywheel, fitted with water circulating pump, cooling fan, fuel tank and air filter, but no radiator or cooling tanks.

A.C. MOTORS

400/440 volts, 3-phase, 50 cycles.

No.	H.P.	R.P.M.	Rotor.	Type.	Bearings.	Maker.	Comments.
1	200	750	S.R.	Prot.	B.B.	G.E.C.	NEW. With starter
2	60	480	S.R.	Prot.	B.B.	E.E.C.	With starters
1	40	480	S.R.	Prot.	B.B.	L.D.C.	With new starter
1	40	960	S.R.	Prot.	B.B.	Harland	With starter
1	30	940	S.C.	Prot.	B.B.	C. Parkinson	With starter
10	30	960	S.C.	Prot.	B.B.	E.E.C.	With starters
1	30	715	S.C.	Prot.	B.B.	E.E.C.	With starter
1	27½	725	S.C.	Prot.	B.B.	E.E.C.	With starter
8	25	730	S.C.	Prot.	B.B.	C. Parkinson	With starters
1	20	725	S.R.	Prot.	B.B.	M. & Platt	With starter
3	17½	960	S.C.	P.V.	B.B.	Higgs	With starters
1	15	460	S.C.	T.E.	B.B.	C. Parkinson	With starter
1	15	1430	S.C.	Prot.	B.B.	C. Parkinson	With starter
1	15	710	S.C.	Prot.	B.B.	E.E.C.	With starter
1	15	730	S.R.	Prot.	B.B.	Brook	With starter
1	15	1445	S.R.	Prot.	B.B.	Bull	With starter
1	7½	710	S.C.	Prot.	B.B.	E.E.C.	With starter
8	7½	960	S.R.	Prot.	B.B.	G.E.C.	NEW. With starters
1	5	1500	S.C.	Prot.	B.B.	G.E.C.	NEW
7	5	1500	S.C.	Prot.	B.B.	E.E.C.	
5	3	3000	S.C.	Prot.	B.B.	K. Blackman	
5	2	3000	S.C.	Prot.	B.B.	L.D.C.	
4	2	1000	S.C.	F1.P	B.B.	Brook	
5	15/7½	945/478	S.C.	Prot.	B.B.	L.D.C.	Pole-changing
1	1	960/242	S.C.	Prot.	B.B.	Higgs	Geared
1	1	960/31	S.C.	Prot.	B.B.	M. & Platt	Geared
1	½	100	S.C.	T.E.	B.B.		Geared
1	½	52	S.C.	T.E.	B.B.		Geared
1	1½	75	S.C.	T.E.	B.B.	NEW	Geared
1	1½	39	S.C.	T.E.	B.B.		Geared
1	1	64	S.C.	T.E.	B.B.		Geared
1	1	26	S.C.	T.E.	B.B.		Geared

230 volts, single phase, 50 cycles.

1	¼	30	R.I.	T.E.	B.B.		Geared
1	½	80	R.I.	T.E.	B.B.		Geared
1	¾	50	R.I.	T.E.	B.B.		Geared
1	¾	100	R.I.	T.E.	B.B.	NEW	Geared
1	¼	61	R.I.	T.E.	B.B.		Geared
1	½	26	R.I.	T.E.	B.B.		Geared
3	½	100	R.I.	T.E.	B.B.		Geared

D.C. MOTORS

No.	H.P.	Volts.	R.P.M.	Type.	Winding.	Maker.	Bearings.
1	76	220	1260	Prot.	Shunt	Brush	B.B.
1	46	230	650	Prot.	Shunt	E.E.C.	Sleeve with starter
1	10	220	850	Prot.	Shunt	E.C.C.	B.B.
2	8½	220	1750	D.P.	Shunt	Mawdsley	B.B.
1	8	220	1440	F1.P	Comp.	L.S.E.	B.B. with non-flp starter
3	6/18	220	900/750	T.E.	Shunt	C. Chapman	B.B. 65 min. rtd. with cont. & resistances
1	18	110	900	Prot.	Comp.	Veritys	B.B.

D.C. GENERATORS

DIESEL ENGINE DRIVEN:

ONE RECONDITIONED 36-kW, 220/230 volts D.C., DIESEL ENGINE DRIVEN GENERATING SET, comprising Harland compound-wound, 1350 r.p.m. generator, direct coupled to Paxman-Ricardo vertical four-cylinder, type 4 R.Q. engine, mounted on bed-plate and complete with switchboard.

FOUR RECONDITIONED 22-kW, 110/100 volts D.C. DIESEL ENGINE DRIVEN GENERATING SETS, comprising Mawdsley compound-wound generator, 1100 r.p.m., direct coupled to Lister vertical four-cylinder, radiator cooled engine, mounted on bed-plate and complete with switchboard.

TWO RECONDITIONED 18-kW, 100 volts D.C., DIESEL ENGINE DRIVEN GENERATING SETS, comprising L.D.C. generator, compound-wound 1000 r.p.m., direct coupled to Ruston vertical four-cylinder, radiator-cooled engine, mounted on bed-plate and complete with switchboard.

ONE RECONDITIONED 14-kW, 110 volts D.C., DIESEL ENGINE DRIVEN GENERATING SET, comprising Verity generator, compound wound, 1000 r.p.m., direct coupled to National vertical three-cylinder, type 3.D. water-cooled engine, mounted on bed-plate and complete with switchboard.

ONE RECONDITIONED 4-kW, 220 volts D.C., DIESEL ENGINE DRIVEN GENERATING SET, comprising shunt-wound generator 1200 r.p.m., direct coupled to Tangye-Ricardo vertical, single-cylinder, radiator-cooled engine, mounted on bed-plate and complete with switchboard.

ALTERNATING SET:

ONE RECONDITIONED 15-kVA. DIESEL ENGINE DRIVEN ALTERNATING SET, comprising Mawdsley alternator, 230 volts, single-phase, 50 cycles, 0·8 power factor, 1000 r.p.m., direct coupled to Lister three-cylinder, radiator-cooled engine. All mounted on bed-plate.

NEW SINGLE-SPEED GEARED MOTORS

TOTALLY ENCLOSED OR DRIP-PROOF ENCLOSURE.

SUITABLE FOR OPERATION OFF A: 400/440 volts, three-phase, 50-cycles supply.
100/250 volts, single-phase, 50 cycles.
100/250 volts D.C., shunt, compound or series.

HORSE-POWER AVAILABLE: ¼, ½, ¾, 1, 1½ and 2 H.P.

FINAL SPEED AVAILABLE: 480, 436, 406, 362, 350, 300, 280, 262, 245, 235, 220, 210, 200, 175, 156, 150, 135, 117, 110, 100, 88, 80, 75, 70, 64, 61, 53, 50, 44, 39, 34, 30, 29, 26 r.p.m.

Also low range of speed between ¼ and 15 r.p.m. at 100ft.-lbs. torque, and from 0·37 to 9·3 r.p.m at 200ft.-lbs. torque, 0·47 to 13 r.p.m. output at 800ft.-lbs torque, and up to 7 r.p.m. at 1500ft.-lbs. torque.

MISCELLANEOUS

ONE TWIN GLASS BULB MERCURY ARC RECTIFIER, by B.T.H., input 6600 volts, three-phase, 50 cycles; output 150 kW, 460 volts D.C. With two rectifier cubicles, each 75 kW, 230 volts, 326 amps, with link, carrier, cooling fan and motor, control panel, transformer and two bulbs. Complete with D.C. switchboard and A.C. circuit breaker.

ONE RECONDITIONED WALL FIXING HAND-OPERATED OIL BREAK DRAW-OUT CIRCUIT BREAKER, fitted with two magnetic overloads and no-volt release, 400/440 volts, three-phase, 50 cycles, 200 amp. ratings.

If the electrical equipment you need is not listed, please let us have details of your requirements, as the above is an abbreviated list only of the very large stock held of A.C. and D.C. motors, D.C generators, A.C. and D.C. starters, and various other equipment.

FULL PARTICULARS AND PRICES ON APPLICATION

STANLEY ENGINEERING CO. BATH.

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He thinks....

that the raw material or perhaps the product of his factory cannot be handled in bulk by a mechanical or pneumatic plant. There are many men all over the world who used to think the same until they asked our opinion. We have been able to show that the most unpromising materials can be handled mechanically. We have built a large research laboratory where the handling properties of a variety of new materials are being investigated.

Possibly your material is already on our list.
Perhaps we can scrap those bags, barrels, sacks and the like that have to be individually handled, by installing a bulk handling plant. But if your problem is one of handling separate units we can solve that too. We design and build all types of handling plant. Why not write to-day and have one of our engineers visit you for consultation?

Simon Handling Engineers Ltd

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Give your Ropes a chance

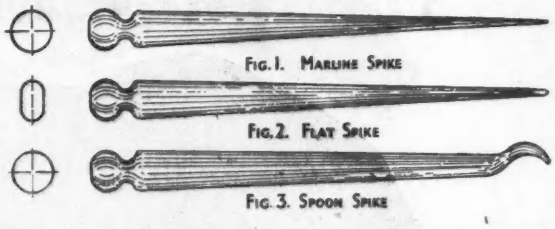

FIG. 1. MARLINE SPIKE

FIG. 2. FLAT SPIKE

FIG. 3. SPOON SPIKE

SPLICE CORRECTLY—THE LONG SPLICE

FIG. 4.

X Y Z

THE CORRECT TOOLS FOR THE JOB

It is essential that the correct tools should be to hand. These are of simple construction but effective in their application.

The necessary tools are as follows :

1. MARLINE SPIKE round in section, tapering to a point at one end (Fig. 1).
2. FLAT SPIKE oval in section, tapering to a point at one end (Fig. 2).
3. SPOON SPIKE similar in shape to the marline spike but having a flat-sided spoon shaped end (Fig. 3).

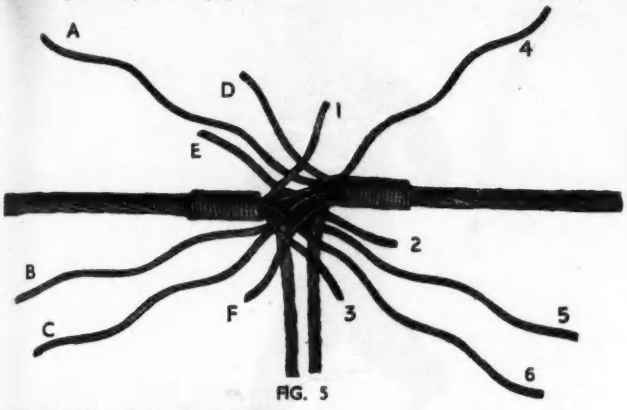

FIG. 5

LENGTH OF SPLICE

Decision as to length of splice must be based on circumstances, but we suggest that to obtain the utmost efficiency from a splice the following rule should be applied—for every 1/8th part of an inch in the diameter of the rope allow 7 feet in length of splice; thus a 7/8 inch diameter rope should have a 49 feet splice.

SPLICING

1. Place the two rope ends alongside each other; measure from each rope end a distance equal to half the intended length of splice (**XY** & **YZ** in Fig. 4); put a temporary binding on each rope end at these points.

2. Unstrand each rope end to the temporary bindings, and cut each alternate strand to within a short distance of the bindings; each rope end should now have three long strand ends and three short strand ends.

3. "Marry" the two rope ends together as shown in Fig. 5, with each strand from one rope end lying between two strands from the opposite rope end, and with the long strand end and short strand end from opposite sides lying adjacent to each other (Fig. 5). The two fibre core ends should protrude from the centre of the rope through the same strand space.

4. Cut away the temporary bindings and then force the two rope ends into each other until each falls into the lay of the other. This is most important, otherwise the lay of the rope will be lost at the point of "marrying", and will spoil the whole splice.

5. Take the short strand end **1** (Fig. 5) and commence to unlay it from rope, at the same time laying the long strand end **A** into the space vacated. Continue with this until within a short distance of the end of strand **A**.

6. Repeat this with strand ends **2** & **B** for a distance equal to two thirds of **XY** and again repeat with strand ends **3** & **C** for a distance equal to one third of **XY**.

7. Repeat instructions given in paragraphs 5 and 6, but in the opposite direction along the rope and using strand pairs **F** & **6**, **D** & **5** and **E** & **4** respectively.

8. Cut off excess length from the long strands and the rope should now be as shown in Fig. 6.

9. Taking each strand pair in turn, uncross the ends as shown at strand ends **A** & **1** (Fig. 6), so as to expose the fibre core and cut this through. Using the marline spike lift out the core ends for a few inches.

10. The strand ends are now ready for tucking, or hiding; this can be achieved by either the "cross-tuck" or the "flat-tuck" methods, we recommend the former, although the latter is the quicker method and, generally speaking, quite efficient. The cross-tuck is obtained by re-crossing the strands after cutting the fibre core and then making the tuck; the flat tuck without re-crossing the strands.

11. Force the flat spike between the two strands through which the tucks are to be made, and pass the spike under two strands; take the spoon spike and place the spoon on the underneath strand of the two strands raised by the flat spike, then with the strand end to be tucked between the spikes, use the spikes as levers to force the strand end into the centre of the rope. Now discard the spoon spike and by rotating the flat spike with the lay of the rope run the tucked end of strand along the centre of the rope until it is hidden, taking the fibre core out to allow this progress to be made, and finally cutting the core so that it "butts" up to the end of the tuck.

12. Repeat this with the opposite strand end and the tuck is complete. Repeat again with each of the remaining strand pairs, finally cutting away the two ends of fibre core at the point of "marrying" and the splice is complete.

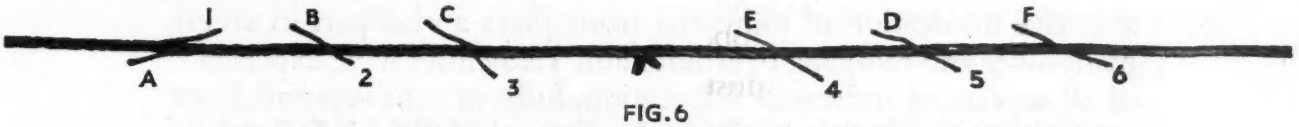

FIG. 6

IMPORTANT POINTS. (a) Straighten out the spiral in the strand ends before tucking.
(b) Wrap the strand ends with a suitable twine, or marline, in order that the outer strand shall 'grip' the tuck properly. N.B If the rope to be spliced has been preformed the strand ends will need binding with a fairly heavy twine, or marline.
(c) It is suggested that an inexperienced Splicer should hesitate to put in a service splice, but that he should use these notes as a guide when learning to splice.

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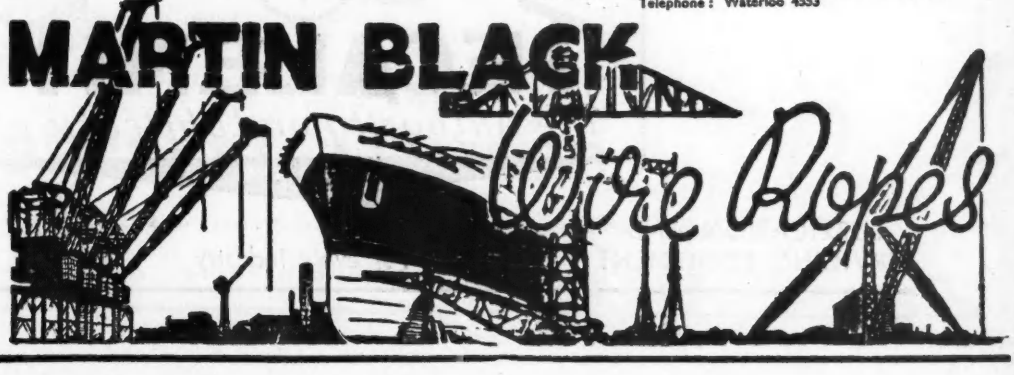

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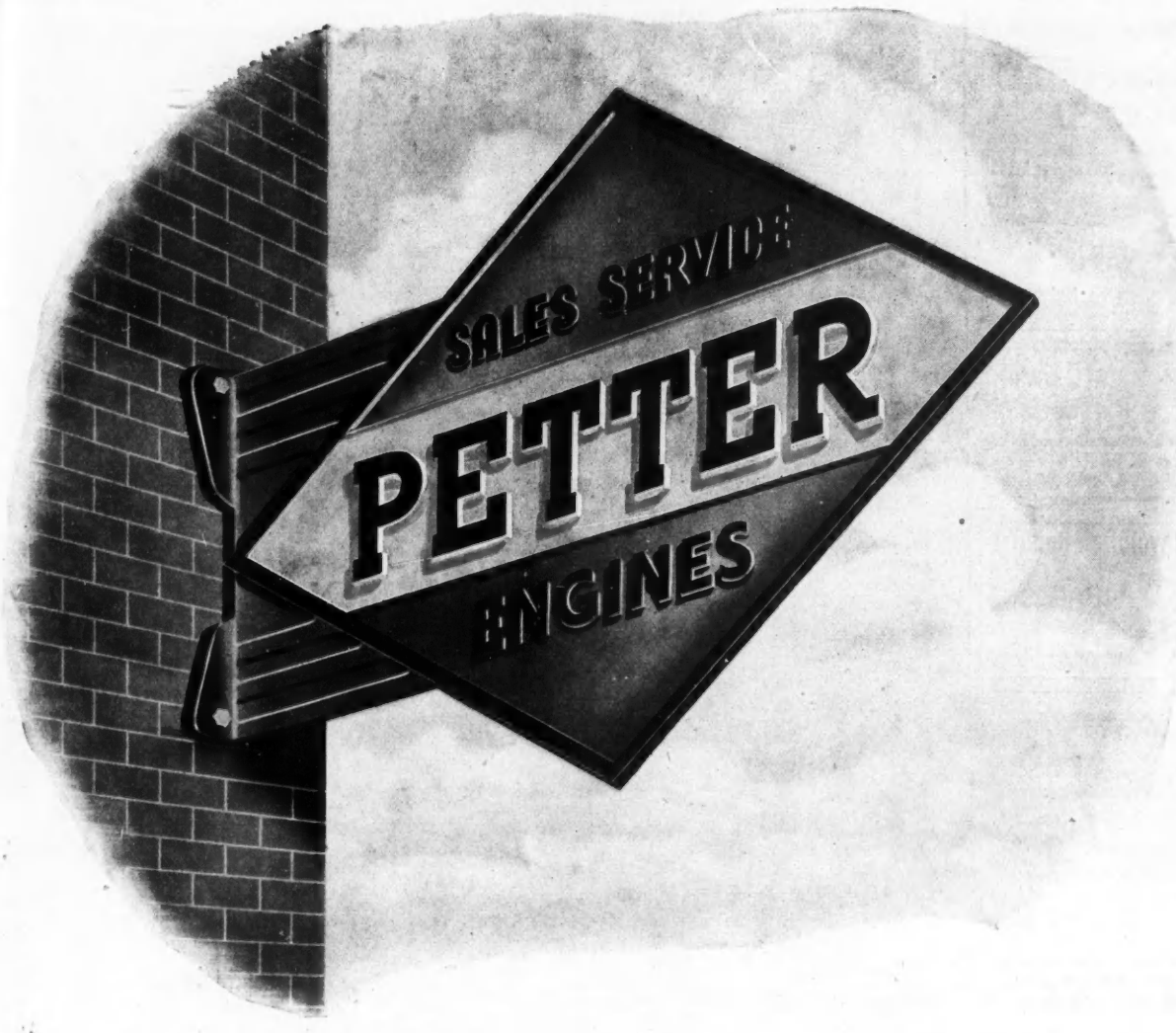

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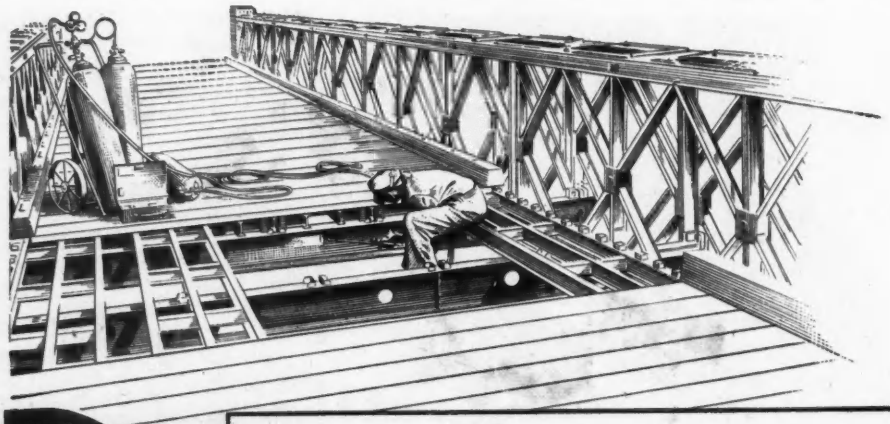

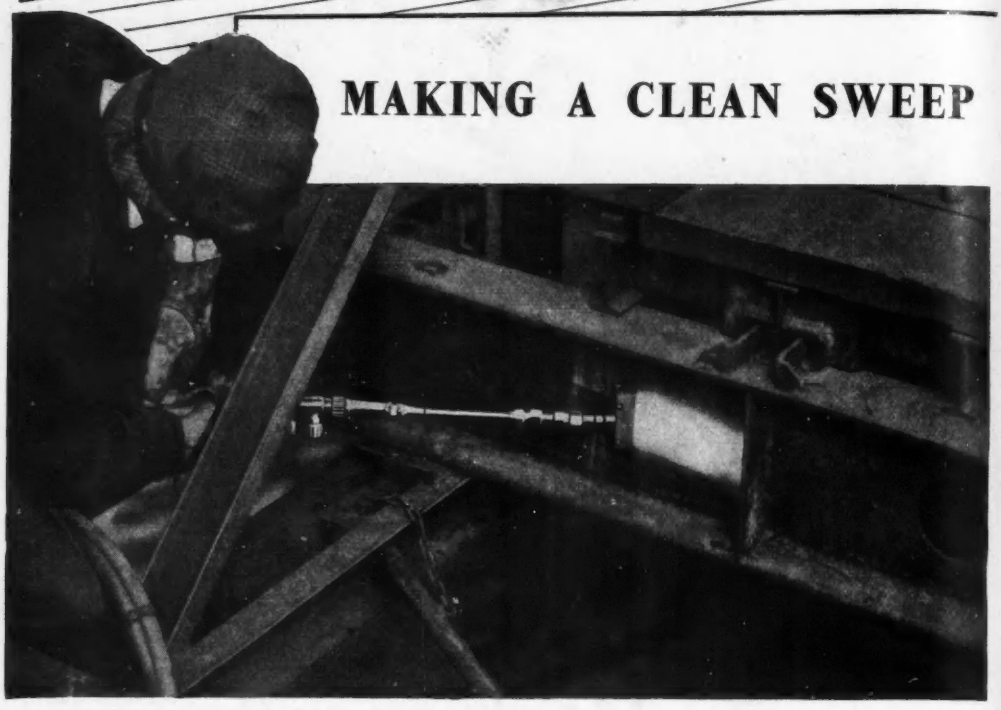

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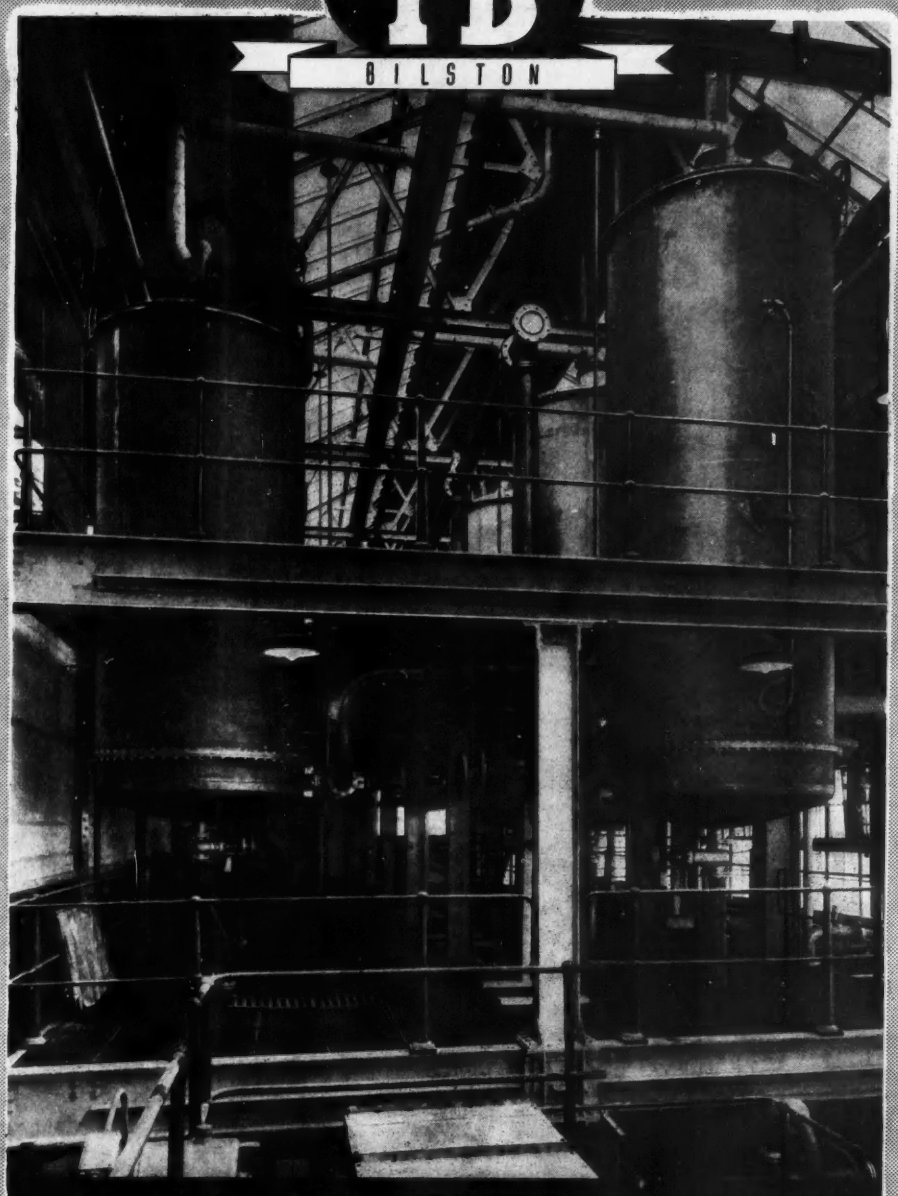

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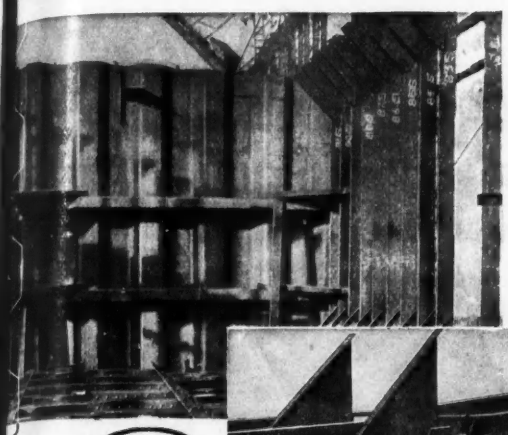

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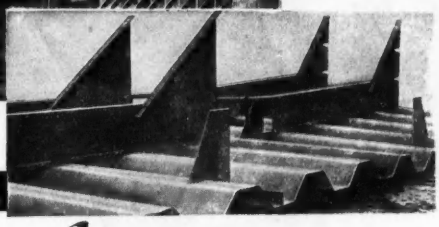

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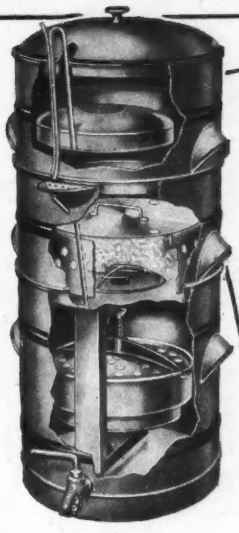

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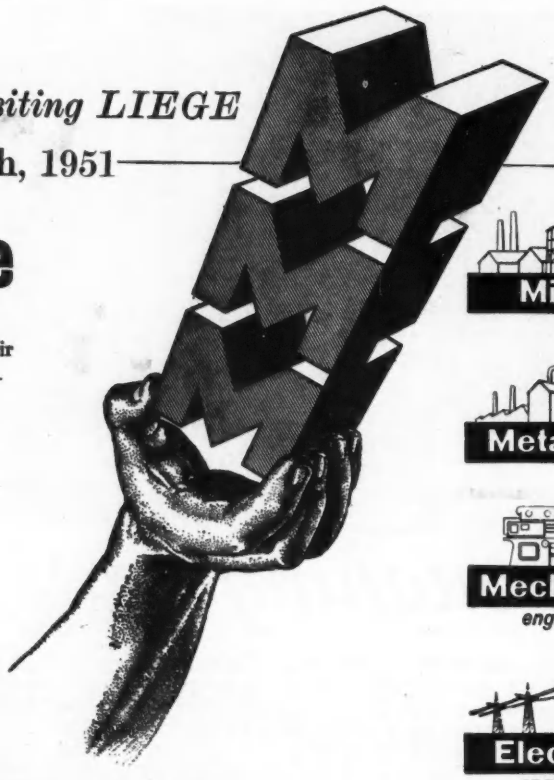

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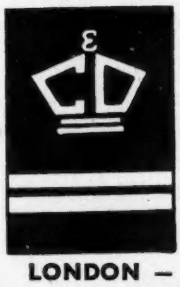

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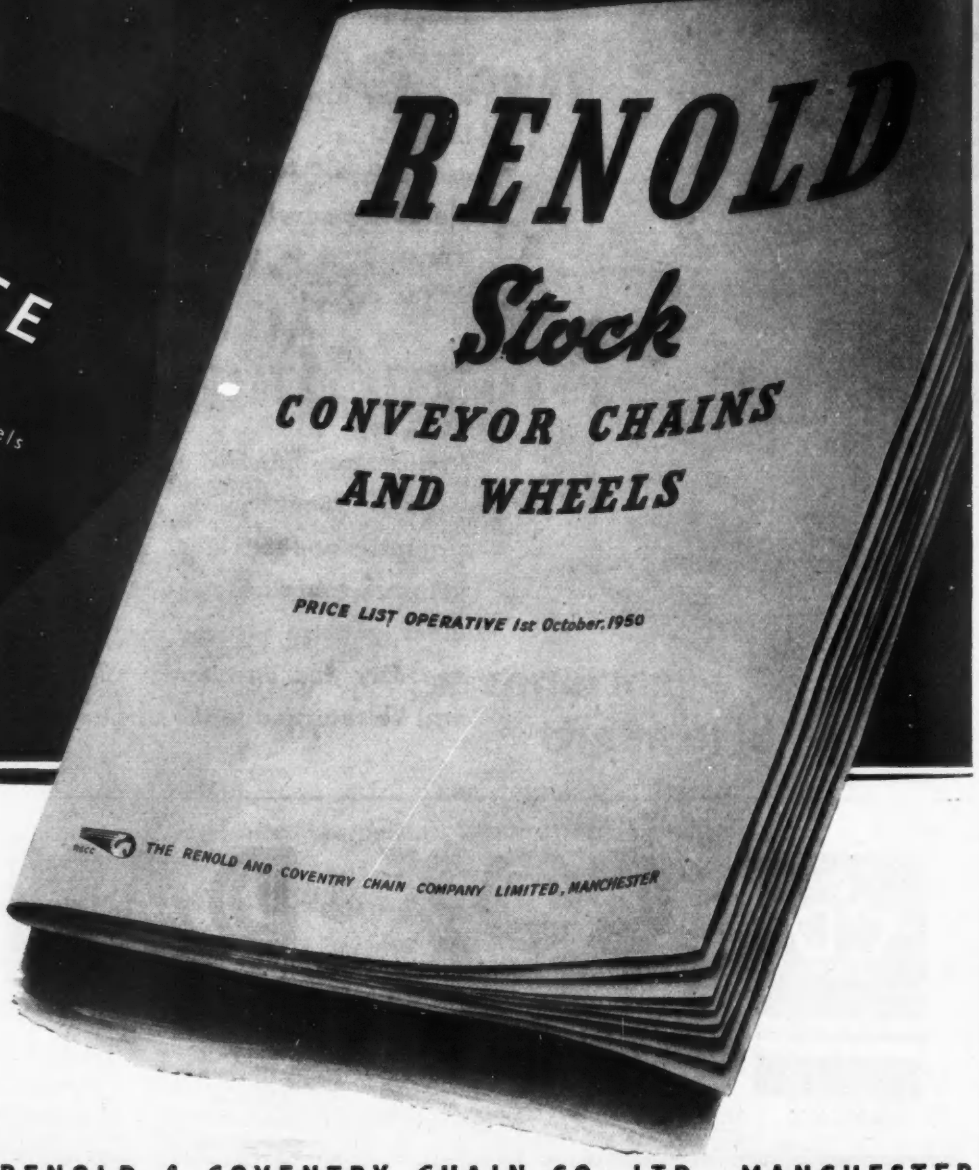

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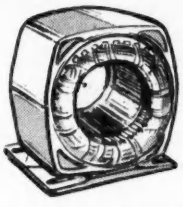

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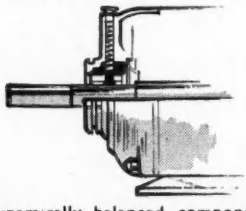

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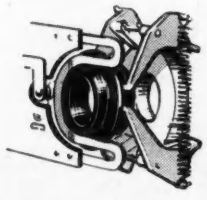

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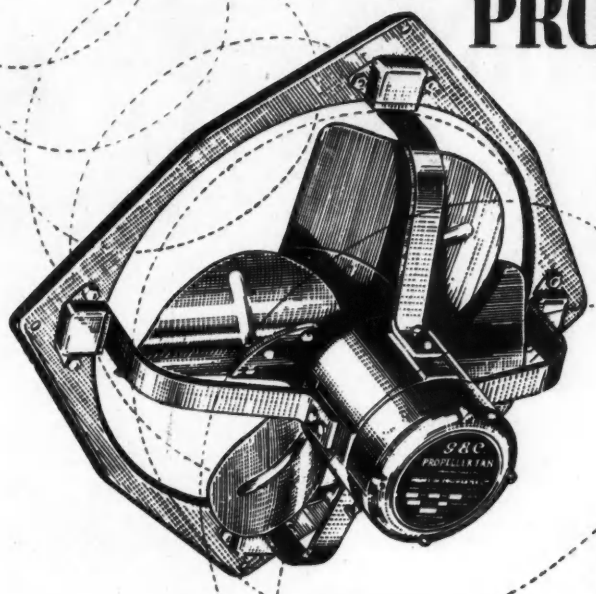

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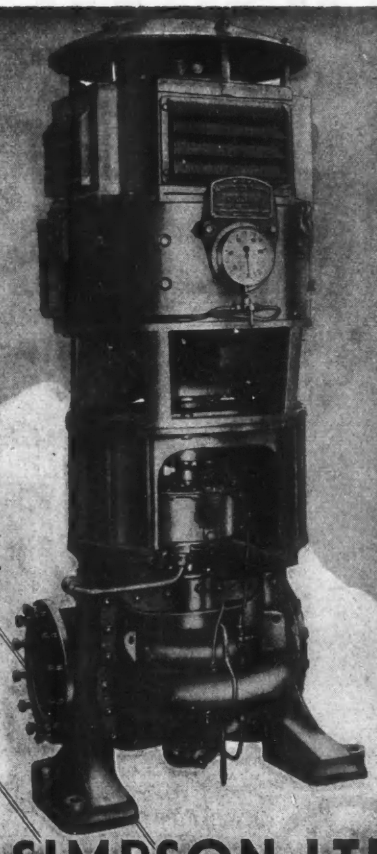

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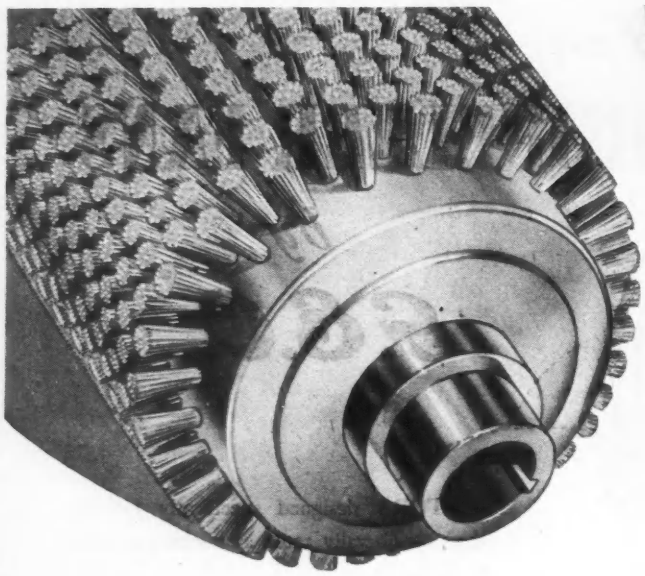

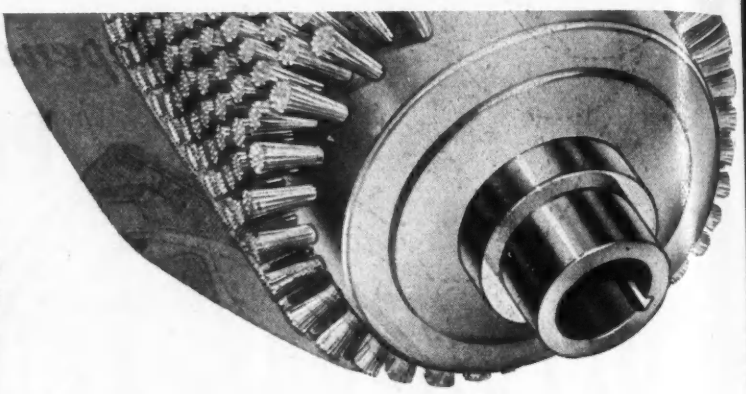

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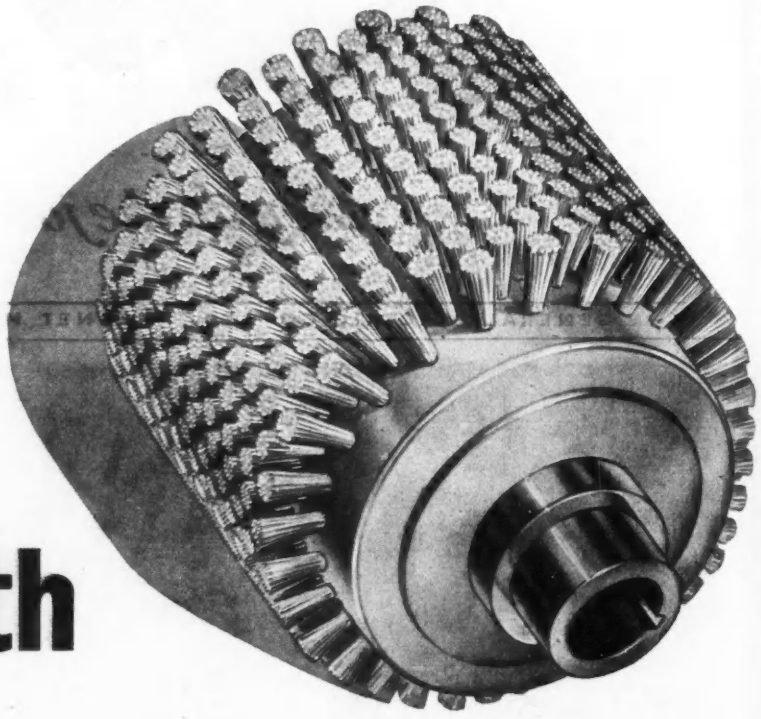

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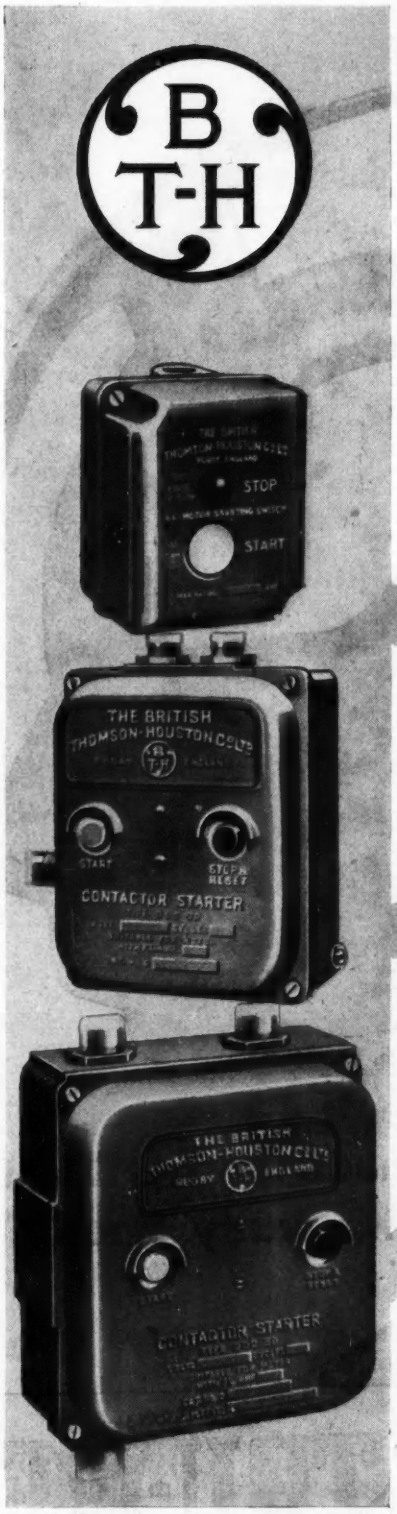

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1/2 H.P. (346/380 v.),
1/2 H.P. (400/550 v.).
Dimensions: $4\frac{3}{4}$" high x $3\frac{7}{8}$" wide x $3\frac{1}{4}$"

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3 H.P. (200/250 v.),
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Dimensions: 7" high x $5\frac{5}{8}$" wide x 4"

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3 H.P. (200/250 v.),
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No manufacturer can offer a wider range of motor-control gear—hand or automatic, rheostatic or electronic—than BTH.

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COMPANY LIMITED, RUGBY, ENGLAND

A Member of the AEI group of companies

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That handlebar he's gripping is made of Tru-Wel tube —so is the whole framework of his trusty steed!

Tru-Wel day by day. You know Tru-Wel tubes much better than you think. They are the handle on the pram, the framework of your favourite chair, the rail you grab so gladly on the bus. They play a hundred familiar rôles—indeed they are part and parcel of our daily life. This is the result of over 20 years' hard work—research, experiment and development. To-day, Tru-Wel tubes are made in straight lengths or manipulated to measure, precision-tested for trouble-free assembly.

TRU-WEL

ELECTRICALLY WELDED STEEL TUBES

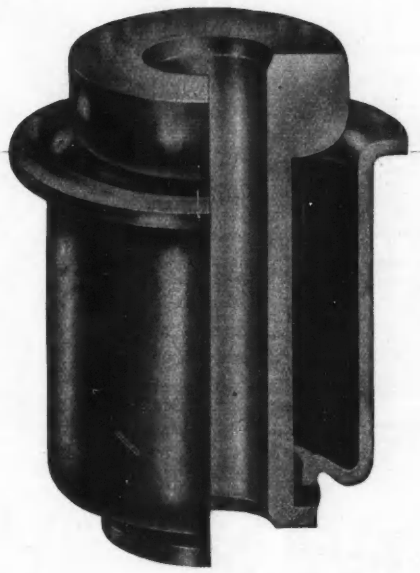
TUBE PRODUCTS LTD., OLDBURY, BIRMINGHAM A TI COMPANY

PERFECT MOUNTING

A Charger for King Charles—and

Silentbloc Anti-Vibration Mountings for Machinery

Scientifically designed to make full use of the high damping capacity of rubber these mountings provide the most effective means of suppressing vibration. They are available from stock in a range of designs and sizes suitable for all kinds of machinery. Silentbloc mountings are easily fitted and give years of trouble-free service without attention.



Silentbloc "Circular Flange" mounting with part cut away to show construction.

The rubber which works in shear is protected by the steel case. Mountings with large circular or triangular flanges are in stock.

If vibration is giving you trouble send for:

SILENTBLOC

Silentbloc Limited, Victoria Gardens, London, W.11.
TEL. PARK 9821

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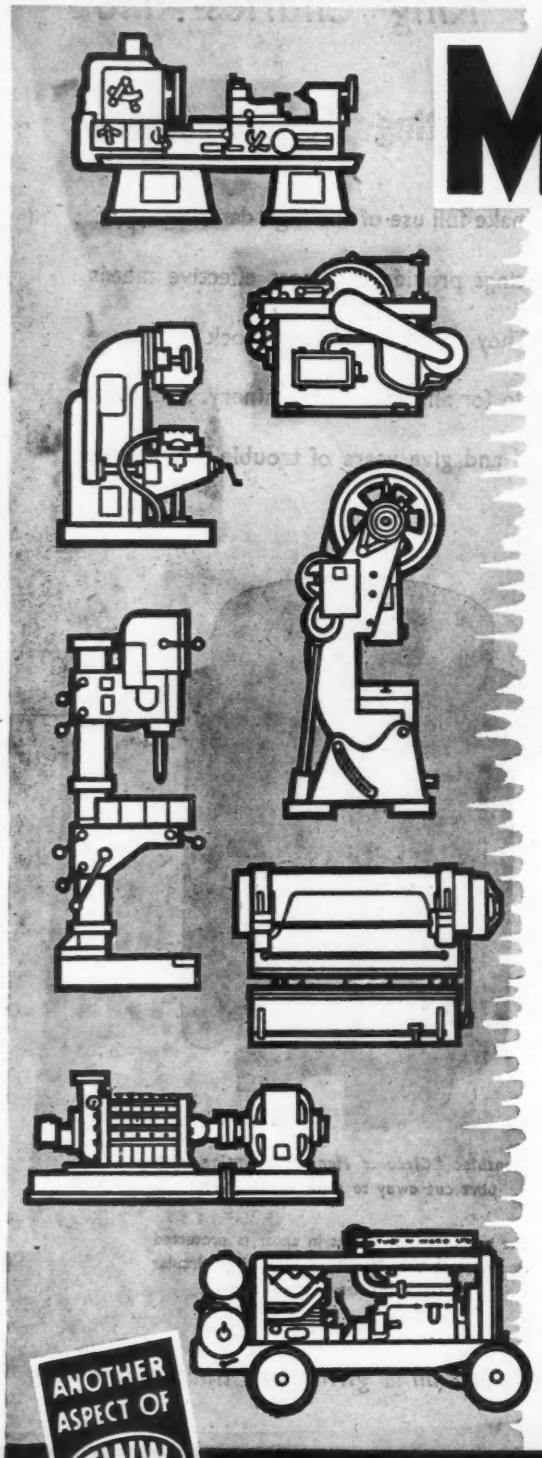

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Whenever you require plant or machinery it is worth bearing in mind that WARDS might have just what you need—new, rebuilt or secondhand—in stock, available for immediate delivery.

The "Albion" Machinery Catalogue lists holdings of modern new, rebuilt and secondhand machinery under the following section headings:

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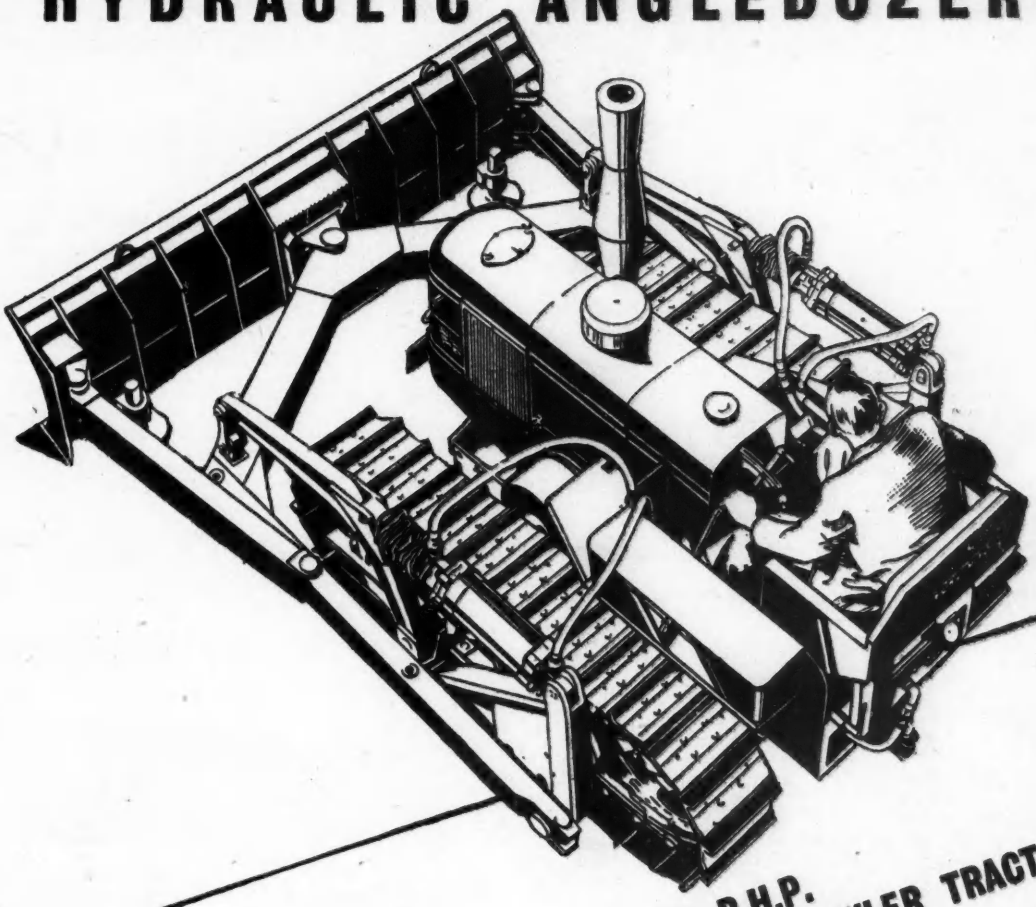
FOWLER LEEDS

1850 1950

MARK VF
BRITISH DIESEL CRAWLER
WITH
HYDRAULIC ANGLEDOZER



THE 40 B.H.P.
FOWLER MARK VF DIESEL CRAWLER TRACTOR

With hydraulically operated angledozer and bulldozer attachment has now proved itself to be the machine for satisfying the needs of medium duty industrial work.

For Fuller details write to

JOHN FOWLER & CO. (LEEDS) LTD., LEEDS 10

Telephone : Leeds 30731

The versatility of this British product is best illustrated by the following features:

- **Capacity up to one cubic yard.**
- **17 trips of 150 ft. at full load in one hour.**
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- **Mouldboard correctly formed to give rolling action to the spoil.**
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- **Early delivery. Enquiries welcomed.**

If Tractor is required for haulage work, conversion is simple and rapid

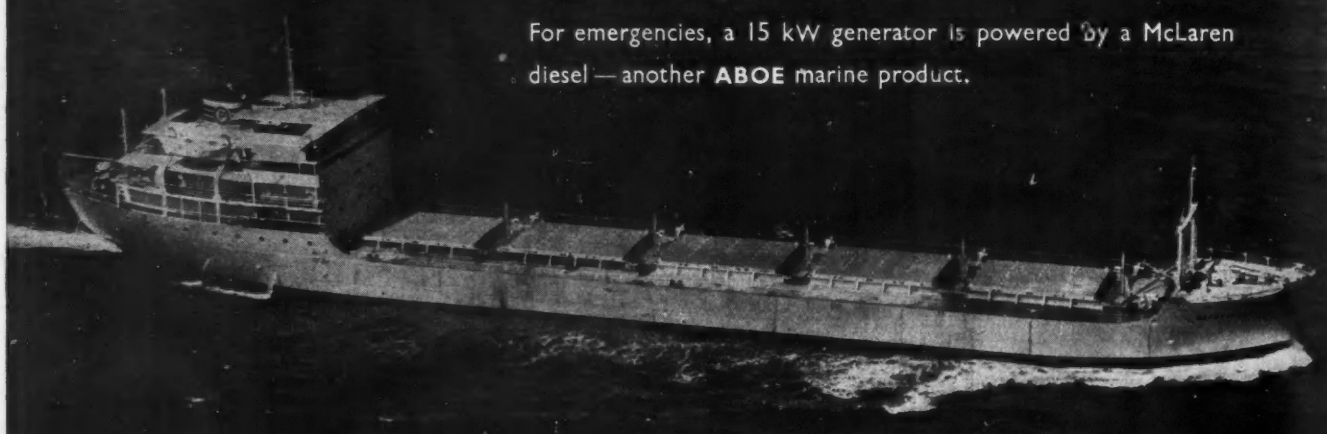
A PRODUCT OF THE MARSHALL ORGANISATION

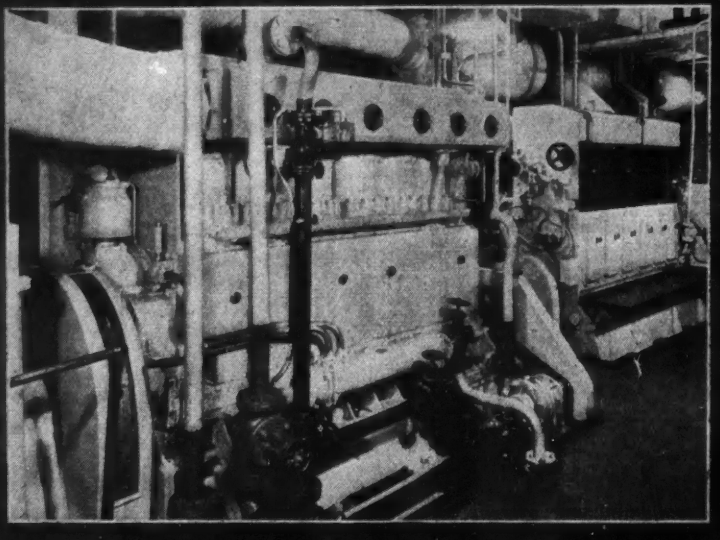
Mirrlees AUXILIARIES...

The M.V. Pathfinder, and her sister ship, the M.V. Prospector, built by R. & W. Hawthorn, Leslie & Co. Ltd., for the Pan-Ore Steamship Company of New York, have recently been delivered to their owners.

Both ships are equipped with three six-cylinder Mirrlees diesel engines. The inset shows two of the three in M.V. Pathfinder. Each engine develops 284 B.H.P. continuously at 600 R.P.M. and drives a 170 kW generator.

For emergencies, a 15 kW generator is powered by a McLaren diesel — another **ABOE** marine product.





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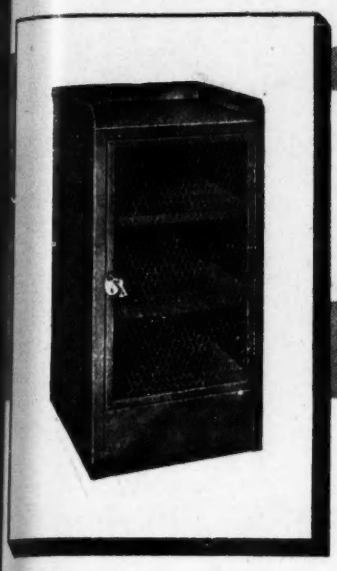
Stop Losses



When each operator has one of these handy lockers, there is an end to tool losses. Time-wasting searches, and bad feeling are also checked, and everyone has an inducement to safeguard their belongings. Complete with Padlock.

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18" WIDE
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Cash with Order.

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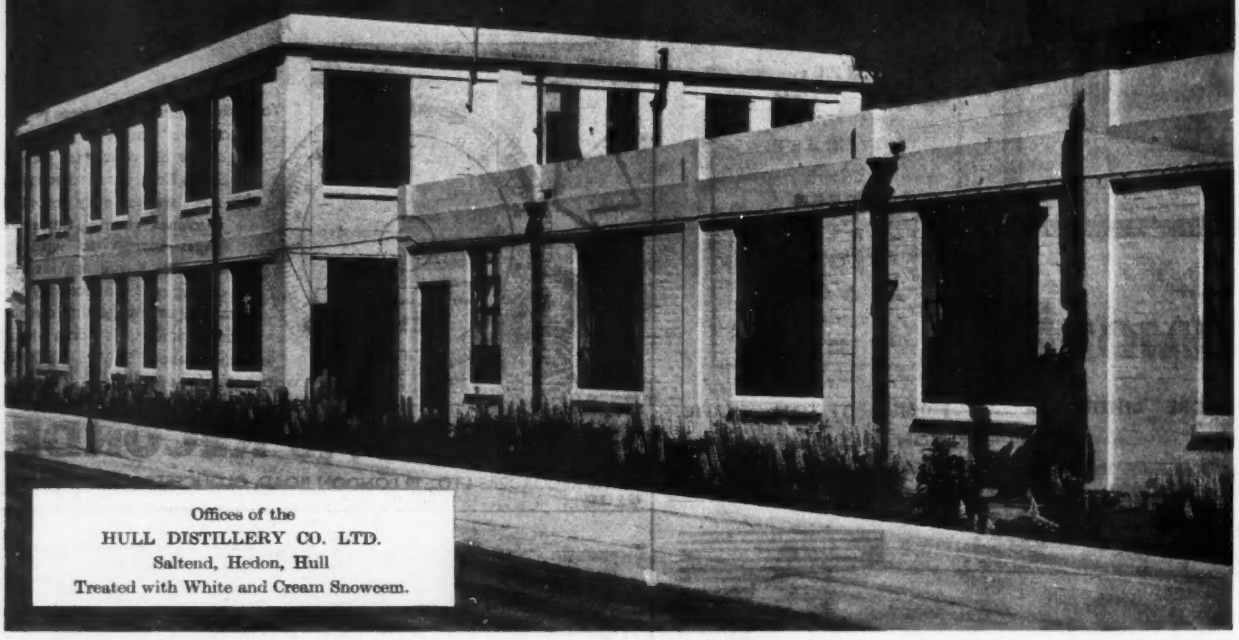

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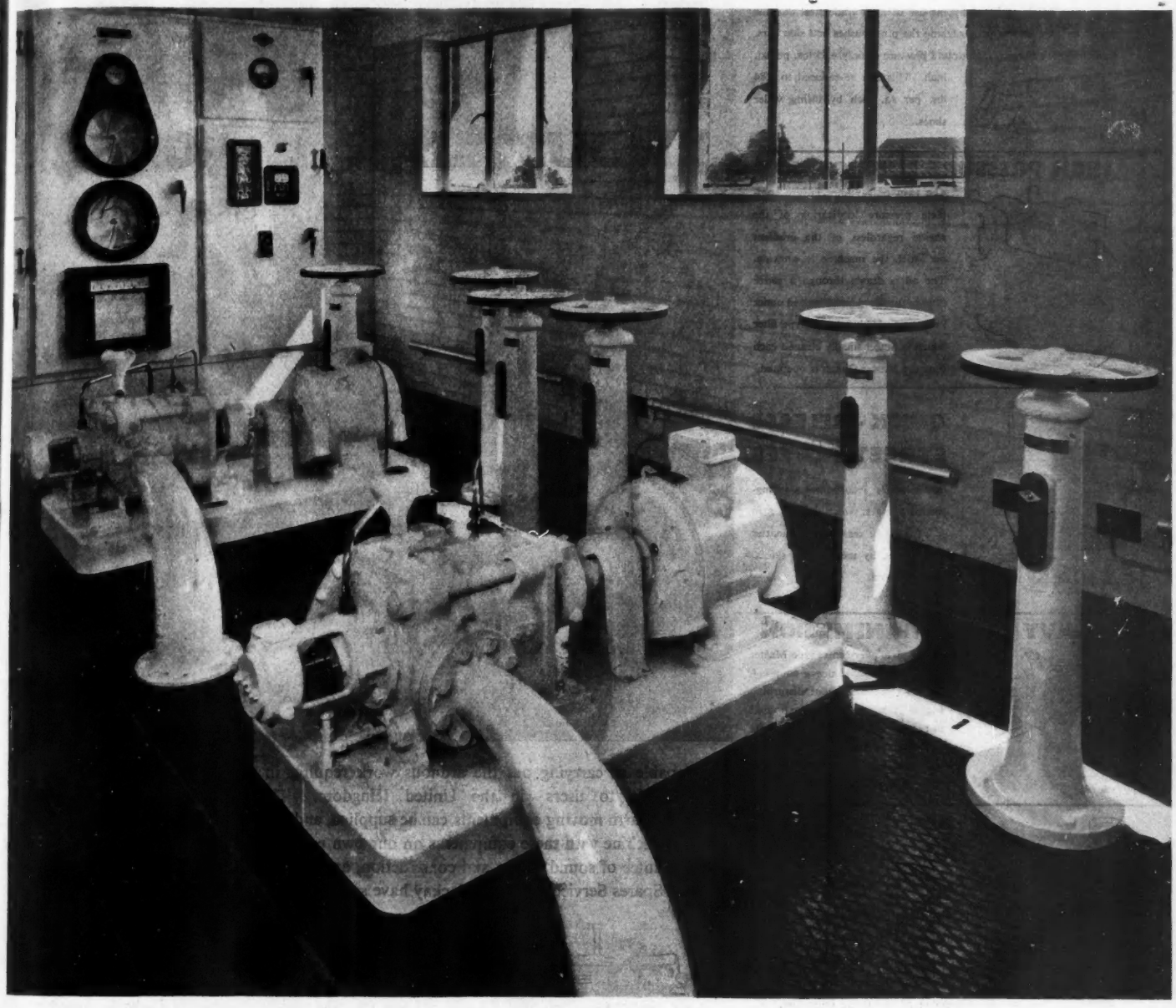
SULZER

CENTRIFUGAL PUMPS FOR WATER SUPPLY



Two Sulzer Sectional Casing High-lift Centrifugal Pumps, to deliver 6,500 gallons per hour against 181 feet or 7,600 gallons per hour against 153 feet total head. Supplied to the Madingley Booster Station of the Cambridge University and Town Waterworks Company.

Philip Porteous, Esq., M.I.C.E., M.I.W.E., Engineer and Managing Director.

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(INCORPORATING HATHORN, DAVEY & CO., LTD.)

SULZER BROTHERS LIMITED HAVE OFFICES AT WINTERTHUR — PARIS — NEW YORK — MADRID — CAIRO — RIO DE JANEIRO — BUENOS AIRES — SHANGHAI — KOBE.
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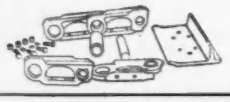
IN FUTURE, IT'S FIAT

WHEEL STEERING

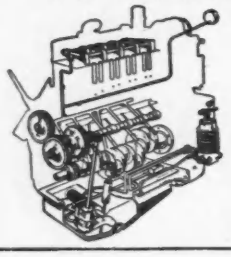
The machine is steered through disc clutches by the operation of the steering wheel. This form of control makes operation easier and gives the driver added support when operating on rough ground.

LONG TRACK LIFE

Long track life is obtained by the use of high grade steel and the special heat treatment for hardening the pins, bushes and side bars. Standard track shoes give a ground pressure of only 4.55 lbs. per sq. inch. This can be reduced to 2.84 lbs. per sq. inch by fitting wider shoes.



HIGH PRESSURE LUBRICATION

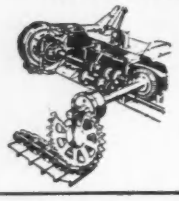


The twin gear pumps ensure complete pressure lubrication of the engine regardless of the gradient on which the machine is working. The oil is drawn through a gauze filter in the sump and is passed under pressure through an edge type filter which is automatically cleaned each time the Master Clutch is operated.

QUICK-RELEASE STREET PLATES

Street plates incorporate a spring-loaded plunger, which enables them to be fitted or removed, in a matter of seconds, by means of a special tool provided.

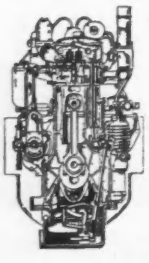
HEAVY DUTY TRANSMISSION



Single plate over-centre type Master Clutch and special sleeve coupling, can be removed without disturbing engine. Transmission system housed in heavy iron casing. Gear shafts supported by heavy duty ball and roller bearings. Reverse and five forward speeds are provided.

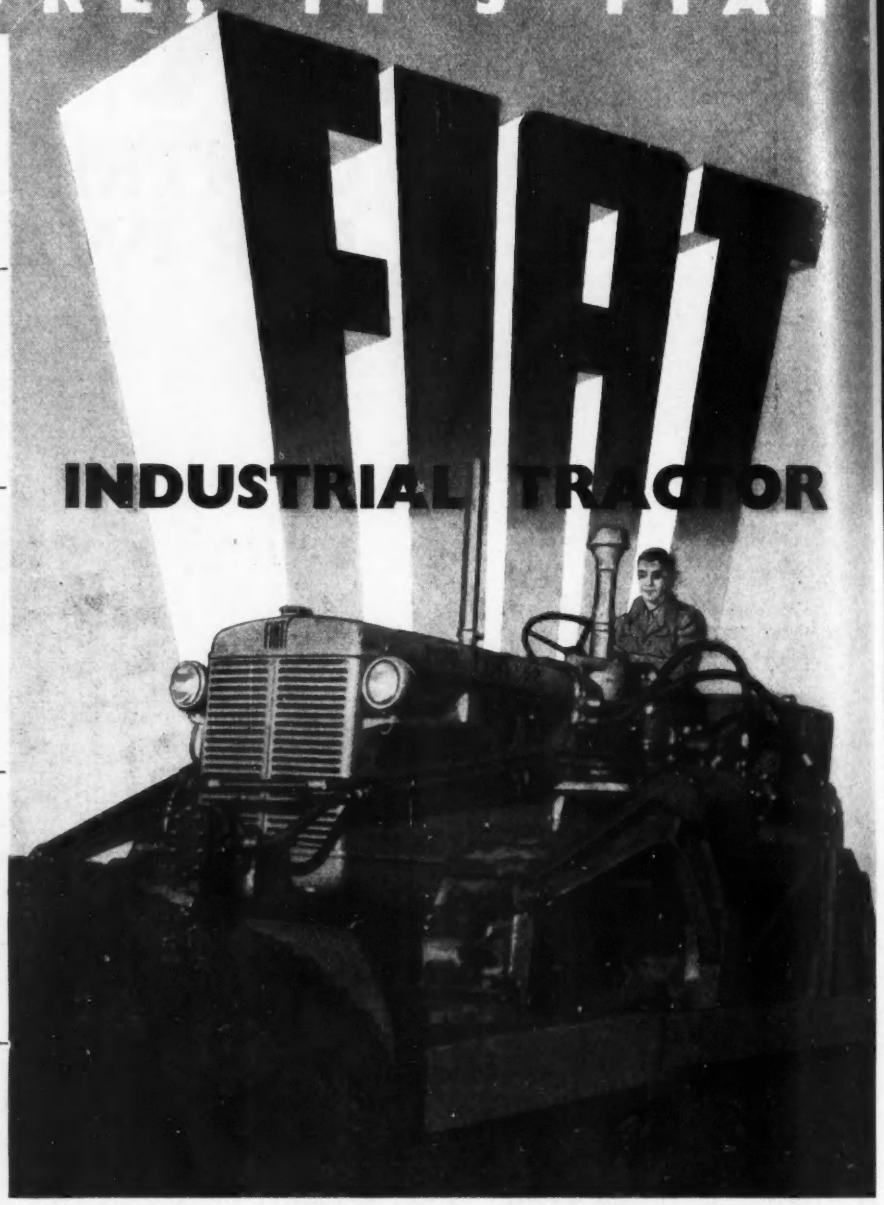
HIGH EFFICIENCY AIR CLEANER

The Air Cleaner gives maximum possible filtration, whilst allowing unrestricted air flow. An oil bath absorbs all large particles of dust, screens and gauzes trapping all remaining impurities.

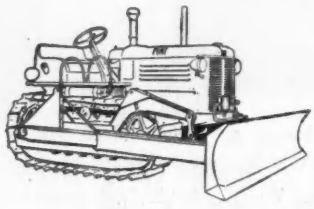


LOW FUEL CONSUMPTION

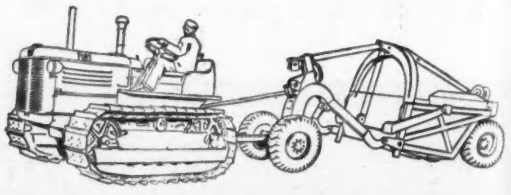
Fuel oil is injected directly into the scientifically designed combustion chambers. Piston crowns and masked inlet valves of special design create double air turbulence, eliminating combustion knock and oil dilution, fuel consumption being reduced considerably and thermal efficiency increased proportionately.



Capable of carrying out the arduous work required in Industry, the FIAT 52 is now available to users in the United Kingdom. The normal range of British Made earth moving equipments can be supplied, and we shall be pleased to demonstrate the machine with these equipments on our own proving ground. The name Fiat is a guarantee of sound design and construction, and all machines are backed by full Field and Spares Service in which Mackay have specialised for more than 10 years.



The FIAT Model 52 can be supplied with a full range of standard industrial equipments, including Hydraulic Angledozers or Bulldozers, Power Control Units and 4 yard Scrapers.



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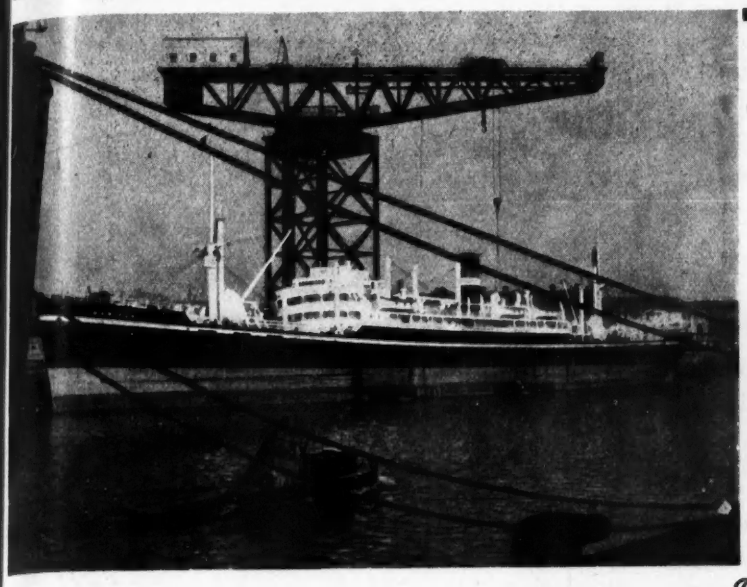

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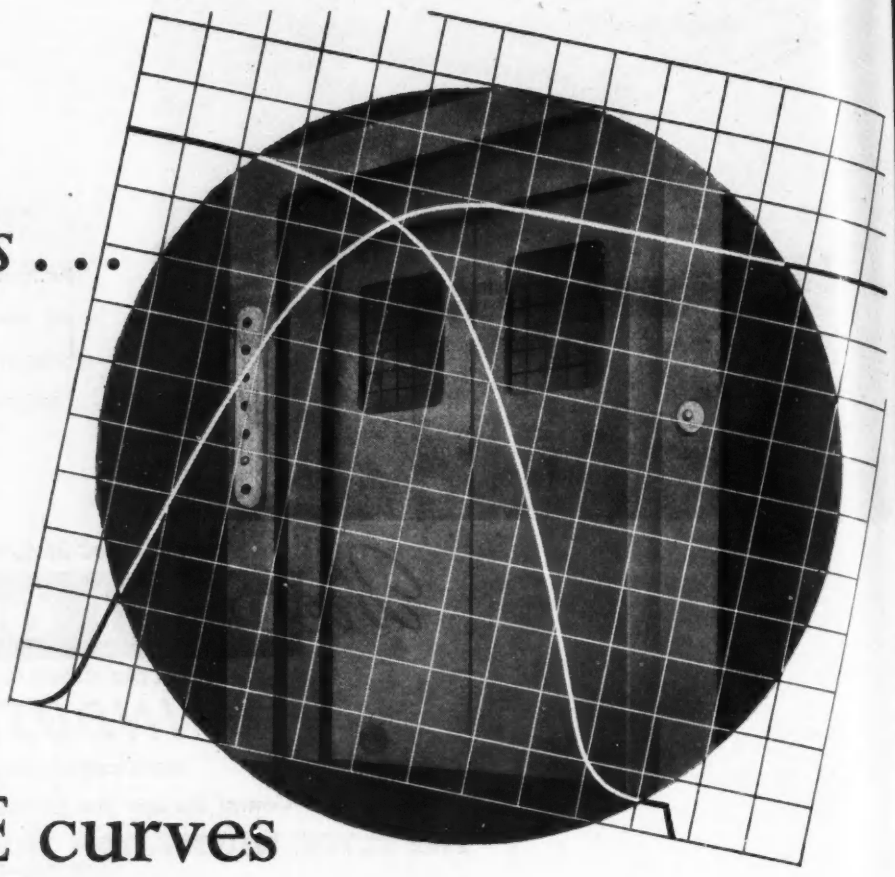

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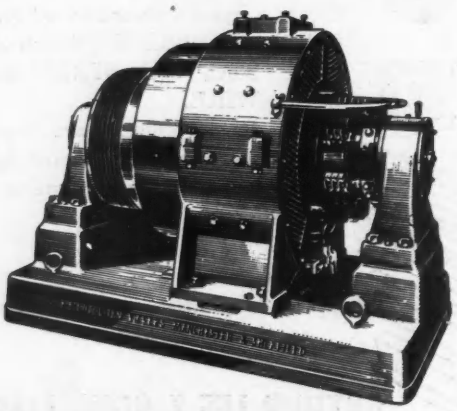
The smooth rate of change of acceleration provided by M-V drives allows high-speed operation with complete passenger comfort. Rapid and accurate "decking" is another feature inherent in the M-V lift drive and control systems. From start to stop and in between, a lift powered by M-V motors gives that faultless service so pleasing to passengers and maintenance men. M-V equipment is backed by the advice and service of engineers who really understand the problem of lift drives.



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TRAFFORD PARK, MANCHESTER, 17.
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METROVICK *Motors for all Industrial Drives*

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CABLE DRAG SCRAPERS
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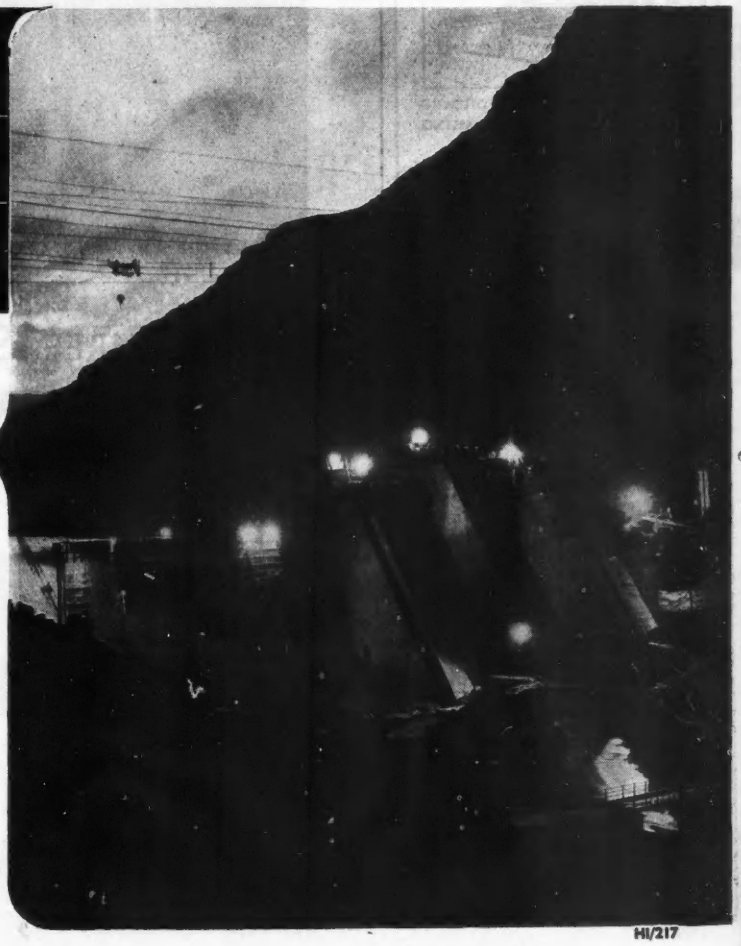

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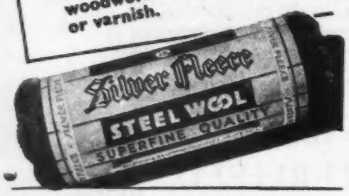

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Electric Cranes of every type
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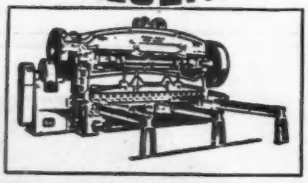

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3196 feet
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DIXEL
ROPE
ON THIS DRIVE

Details of this unusual drive are given in our catalogue No. 255 a copy of which will be sent to those interested.

DIXEL ropes have large H.P. rating and are designed to give efficient service on heavy drives.

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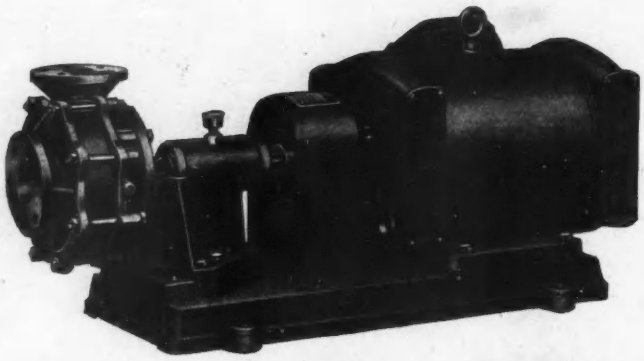
ONE, TWO AND THREE STAGE SMALL CAPACITY
CENTRIFUGAL PUMPS



These pumps are made in four sizes and are fitted with open impellers.

They are supplied for volumes varying from 250 to 12,000 g.p.h. and for heads ranging up to 330 ft.

The pumps are also made as Self-primers by the addition of a water ring air pump.

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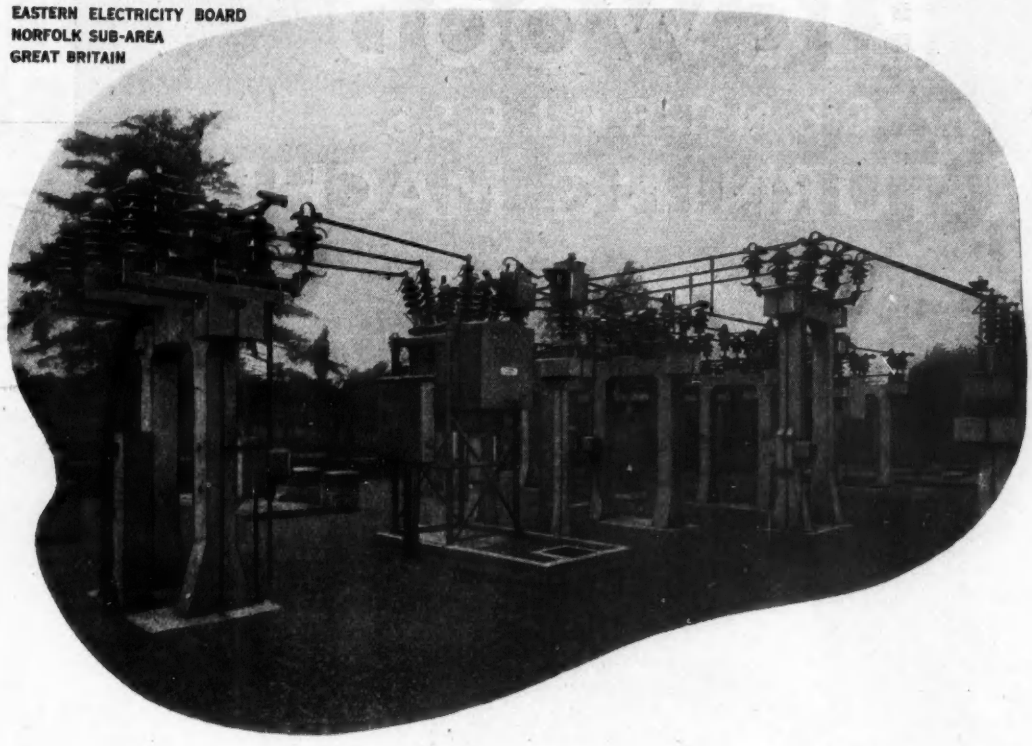

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MADE AT HEBBURN, CO. DURHAM, ENGLAND

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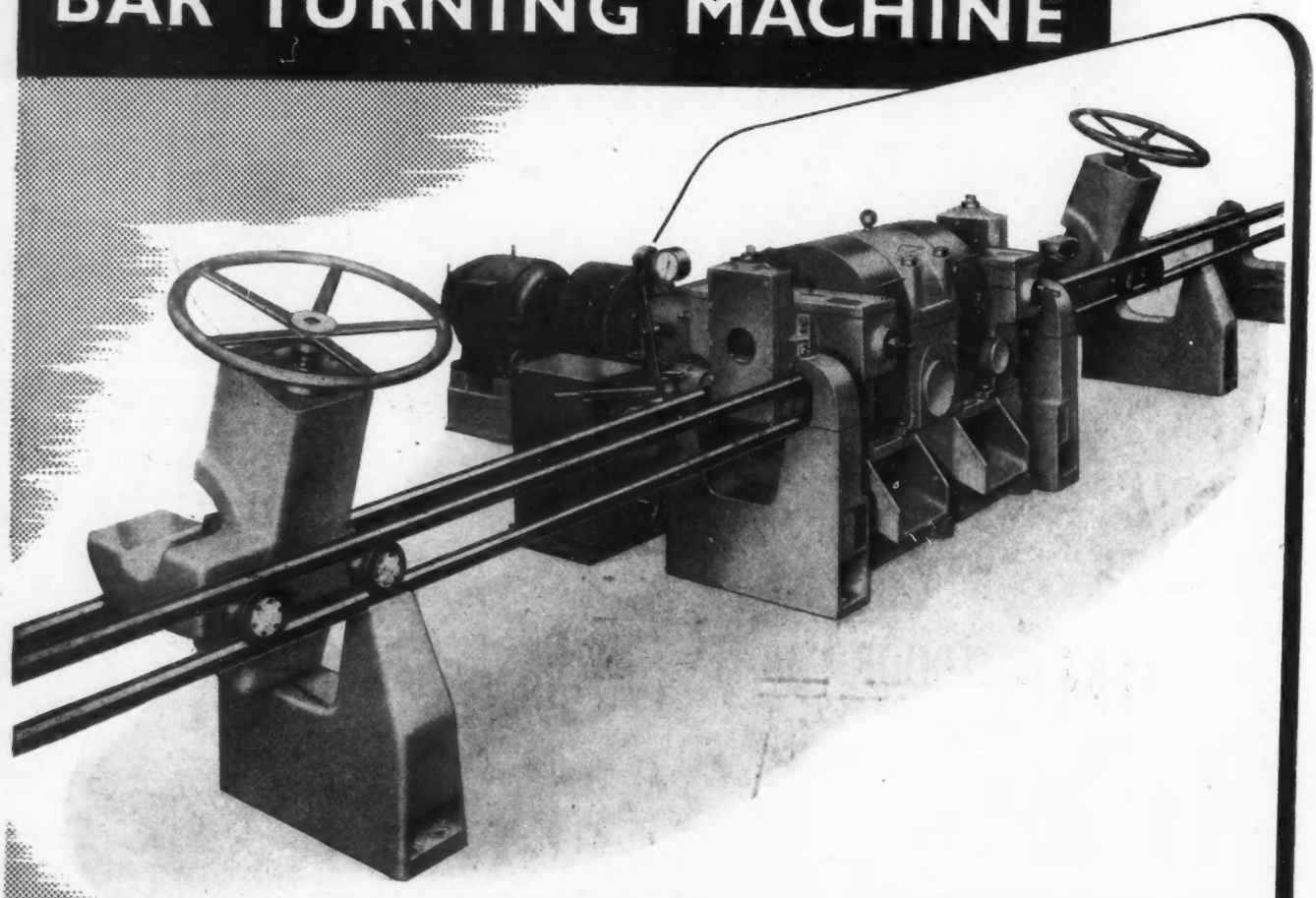
CENTRELESS
BAR TURNING MACHINE



This range of Centreless Bar Turning Machines is for rough peeling or medium turning bars of all qualities. Fitted with variable feed ratio and variable speed for turning heads. This is achieved either by a multi-change gearbox with variable speed driving motors or by fixed speed driving motors followed by "dynamatic coupling" and gearbox, this latter arrangement giving a very fine speed variation. Carbide tipped tools and grinding jigs are provided with interchangeable cutting heads. Tool setting is carried out on a jig away from the machine. Powerful feed rolls and a highly efficient coolant system are provided and the machines are suitable for various ranges between ½" and 7" diameter.

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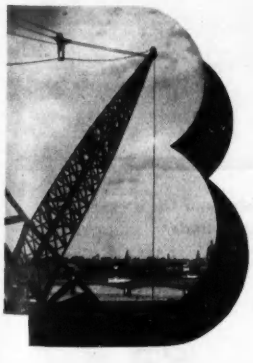

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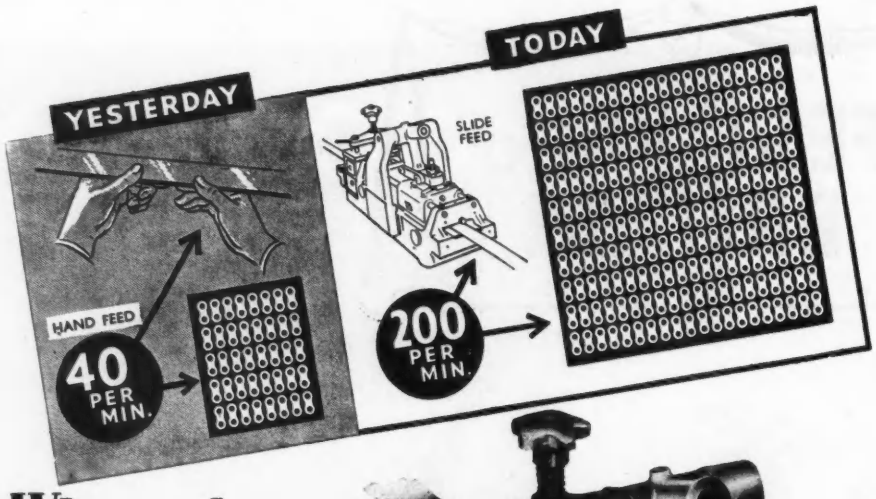

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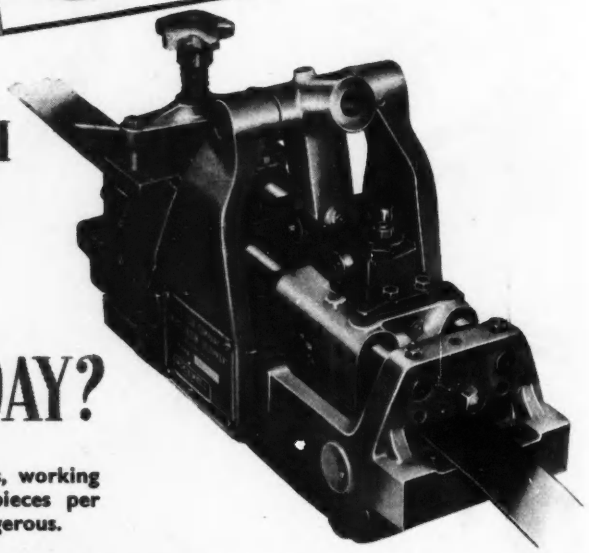

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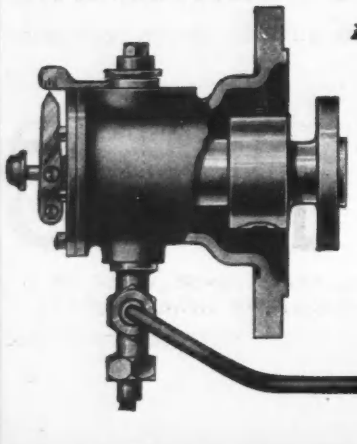
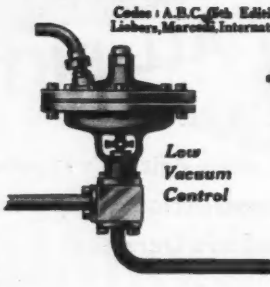
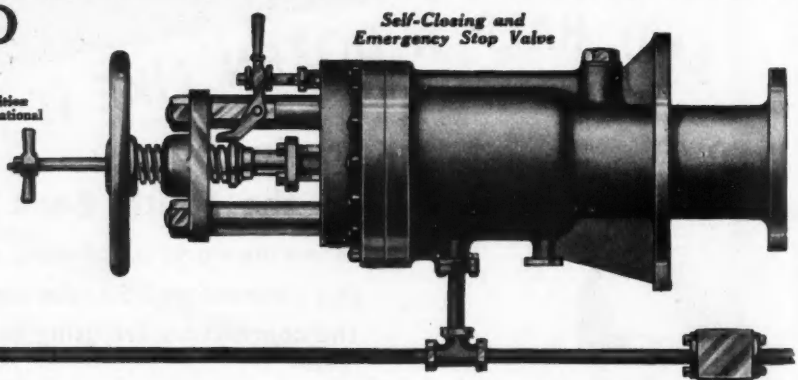


Low Vacuum Control



Self-Closing and Emergency Stop Valve



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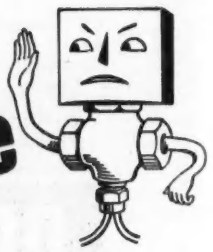
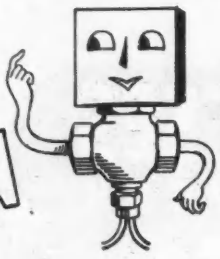
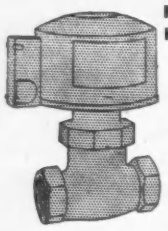


it's an OPEN  and SHUT case

. . . FOR MAGNETIC VALVES



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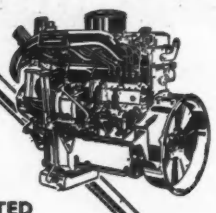

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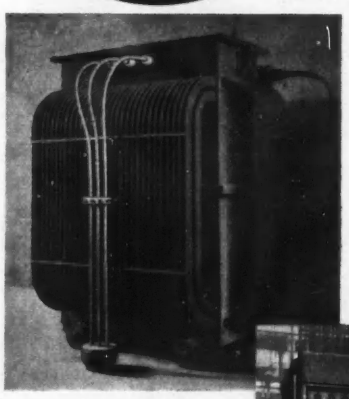

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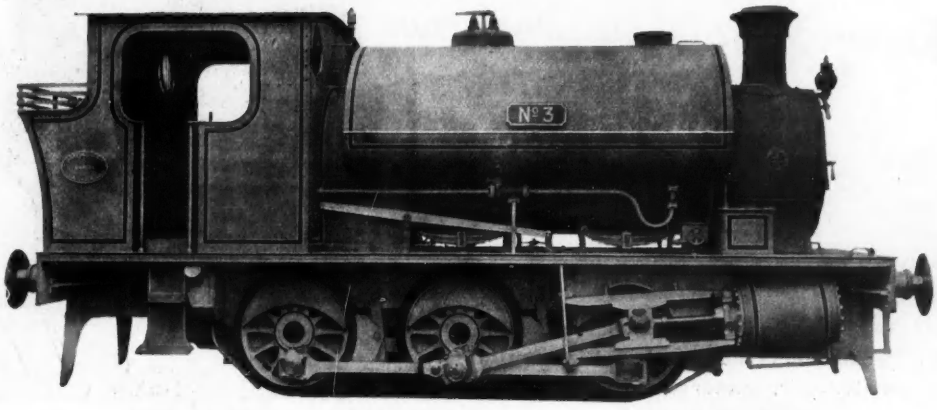

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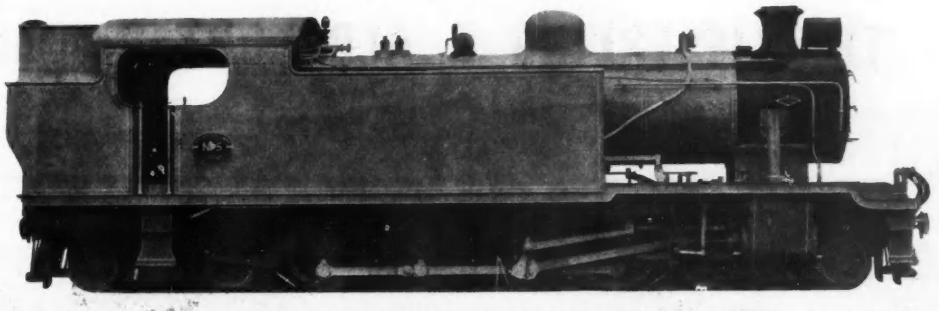

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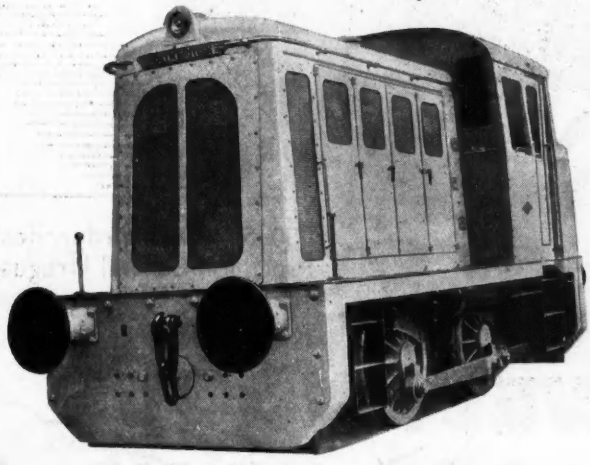

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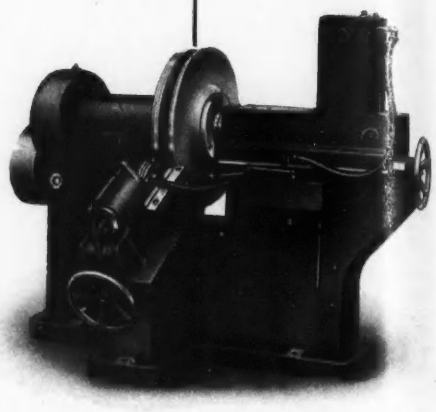

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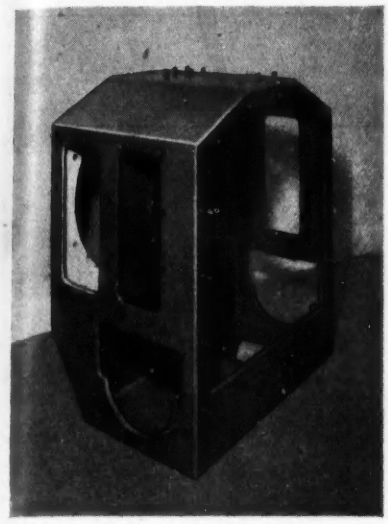

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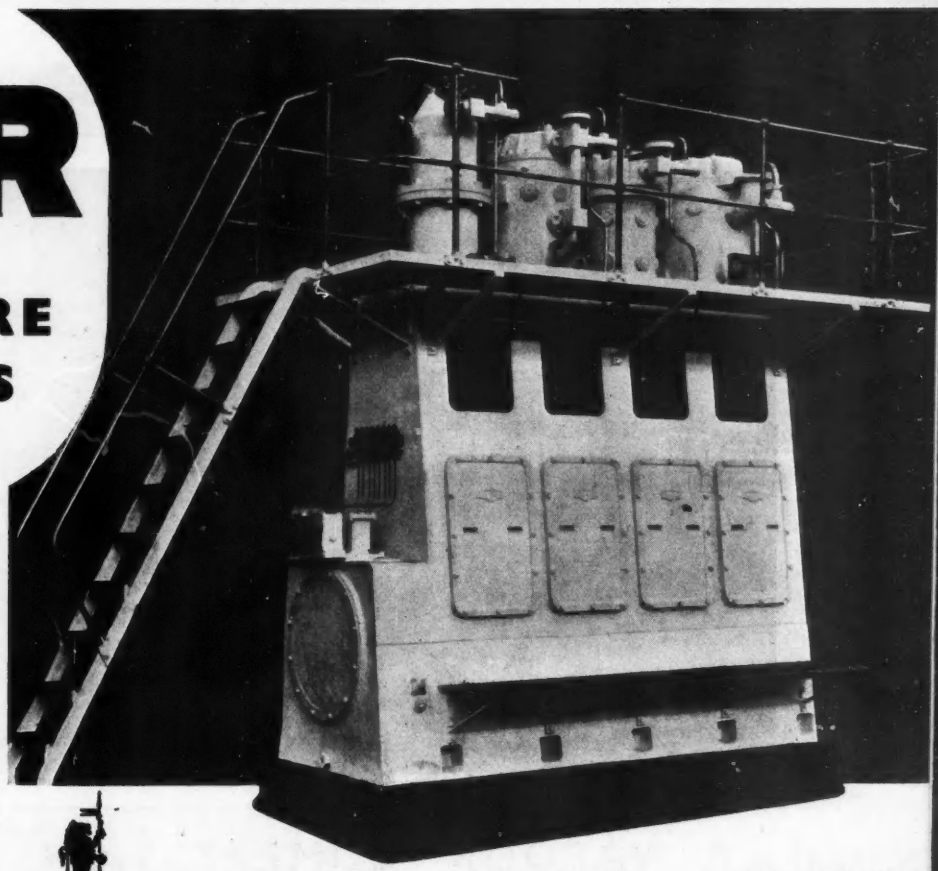

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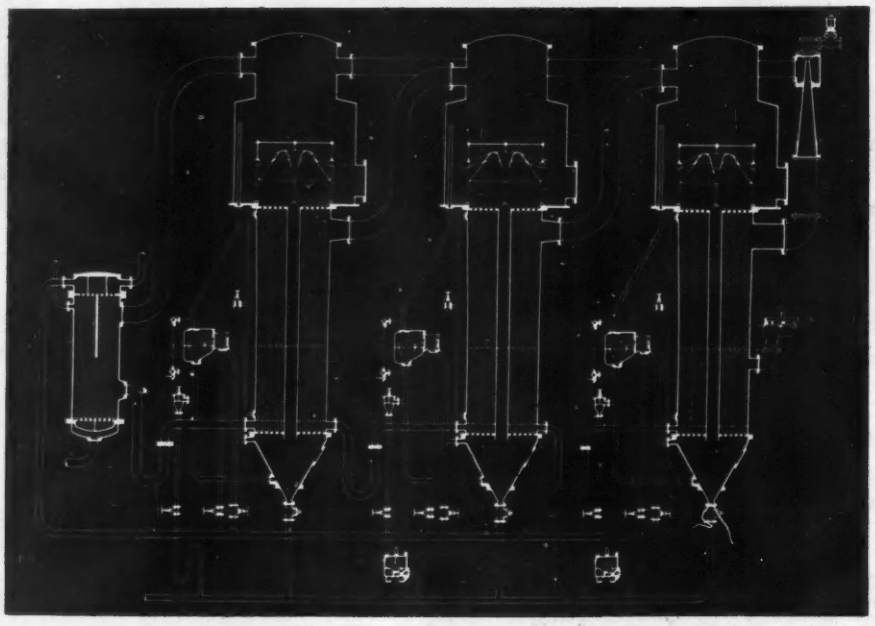

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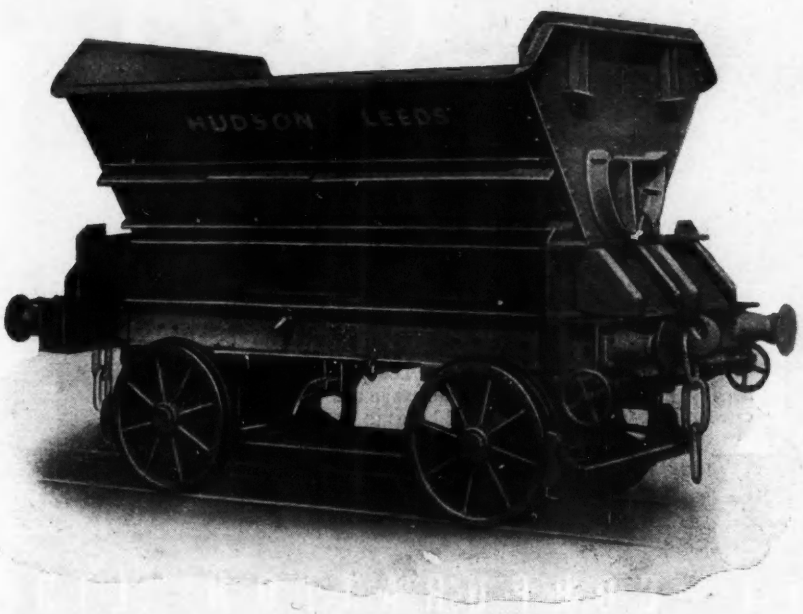

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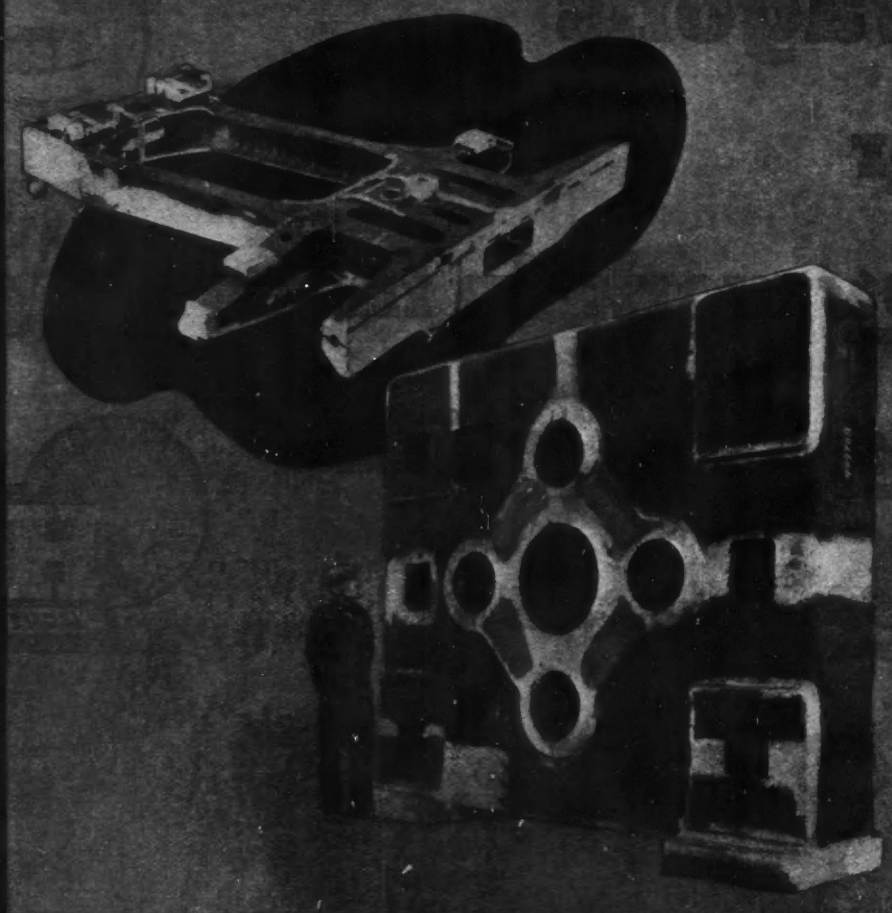

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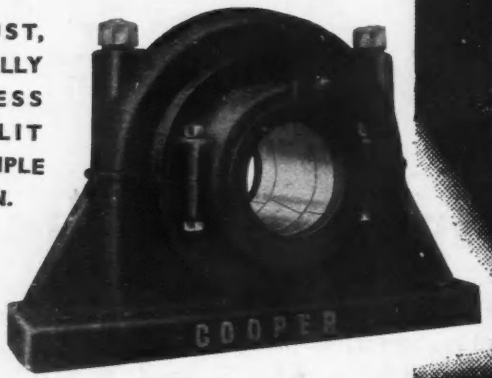

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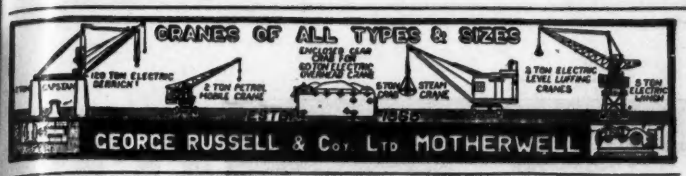

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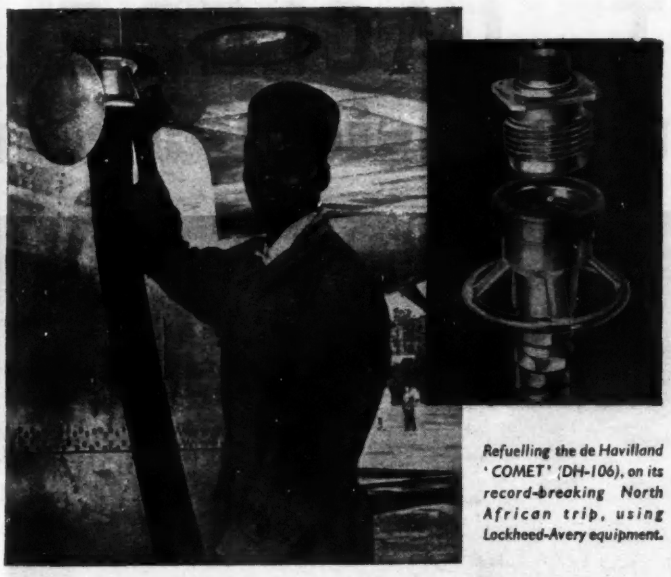

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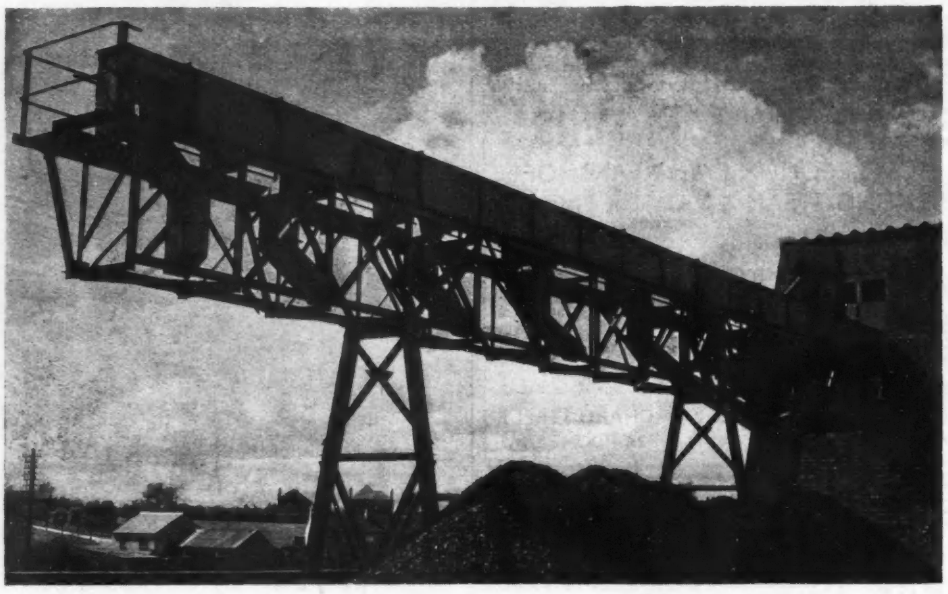

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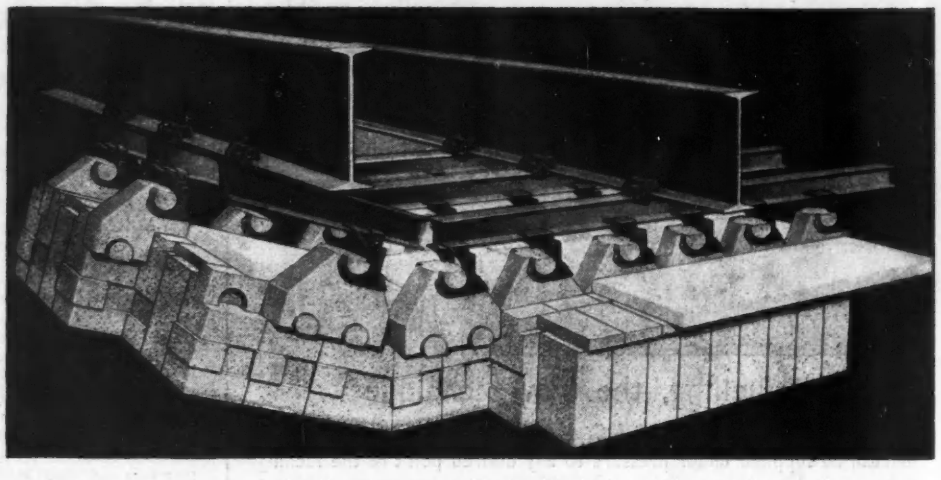

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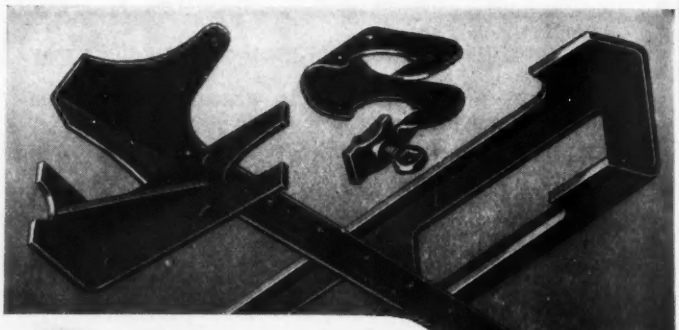

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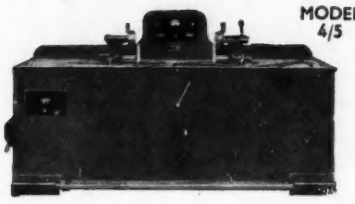

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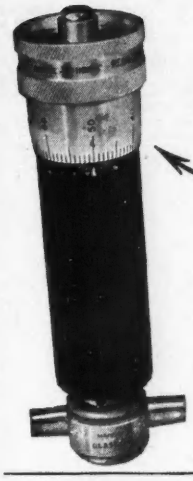

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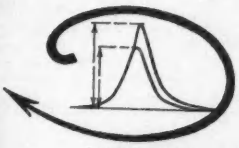

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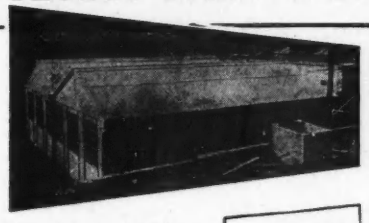

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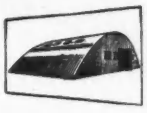

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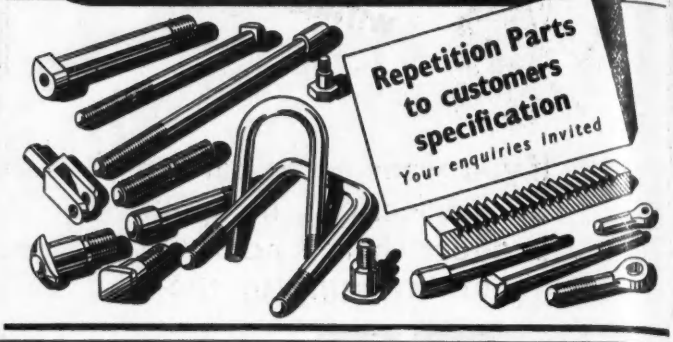

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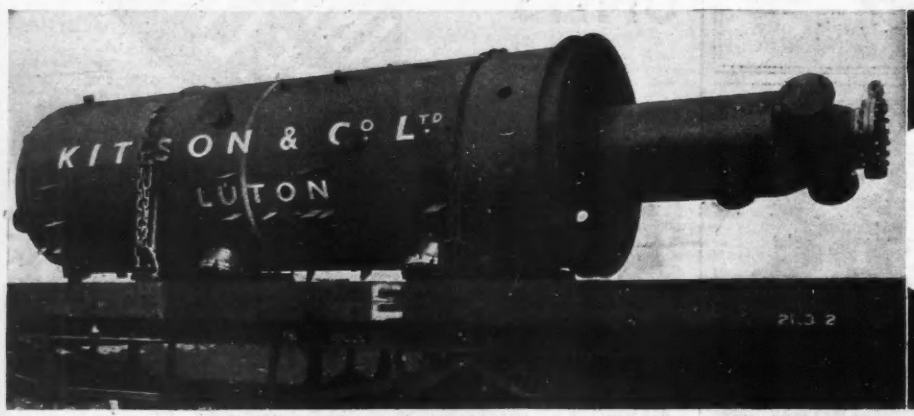

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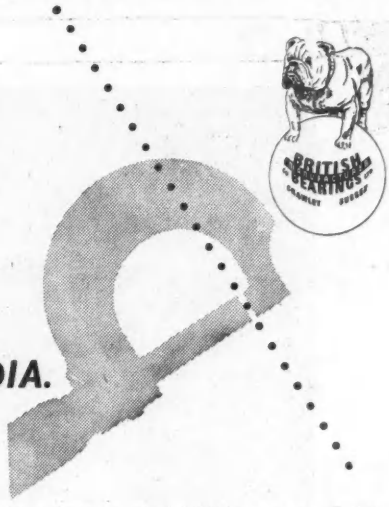

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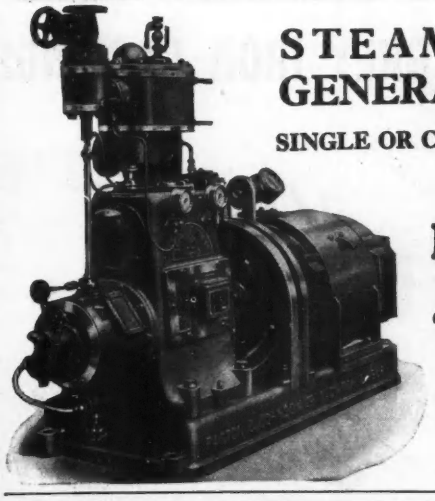

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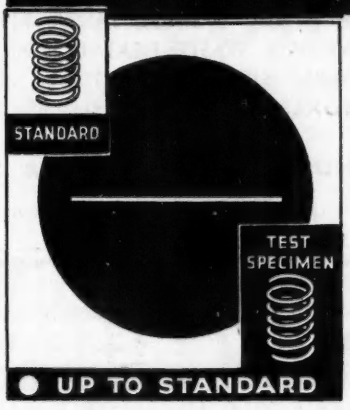

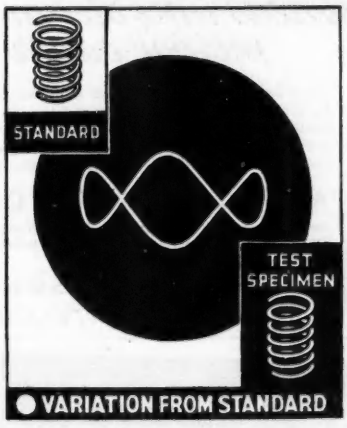

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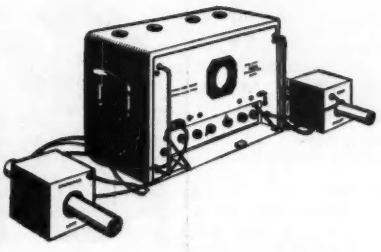

The cathode ray tube screen is shown in the centre of the instrument, the unit to the left containing the standard and that to the right the test specimen.

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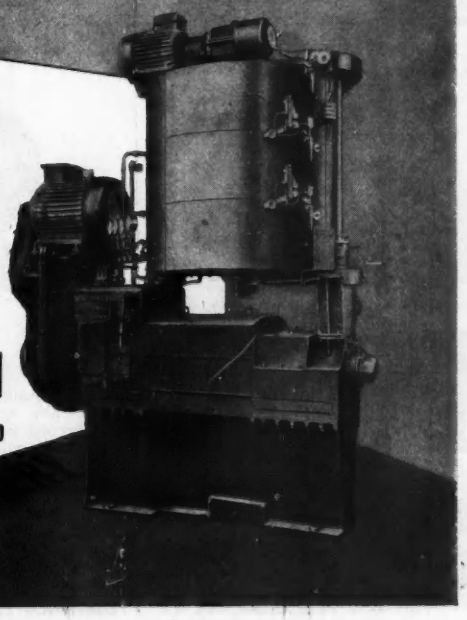

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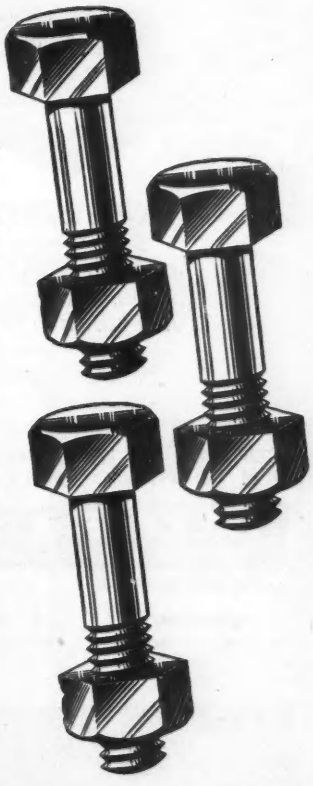

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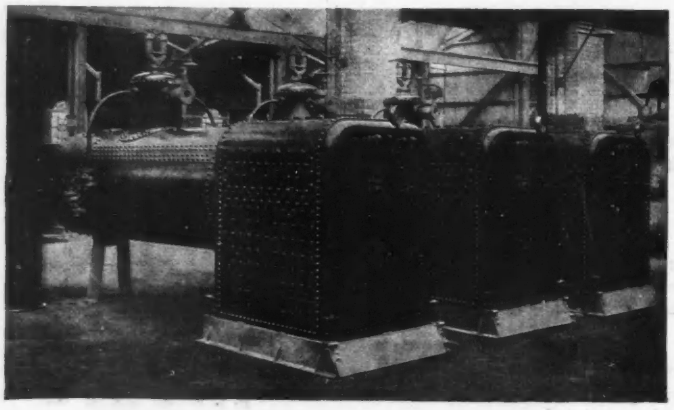

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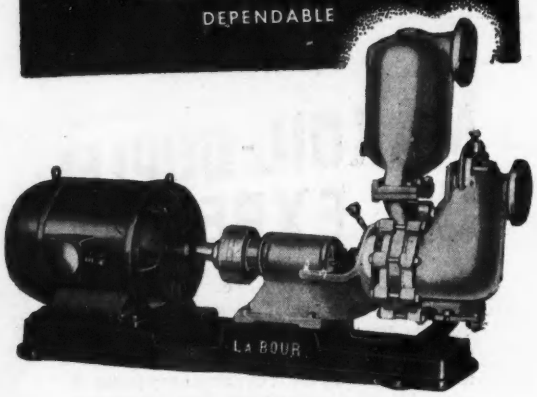

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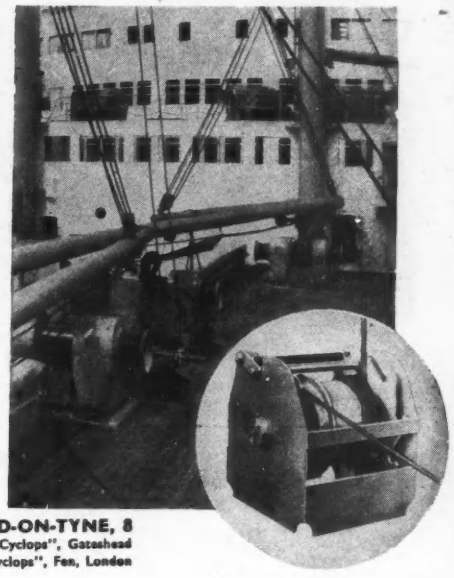

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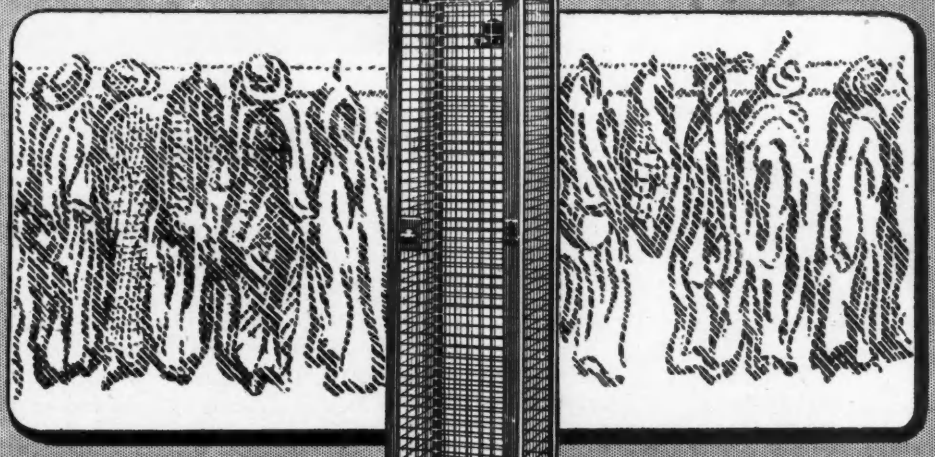

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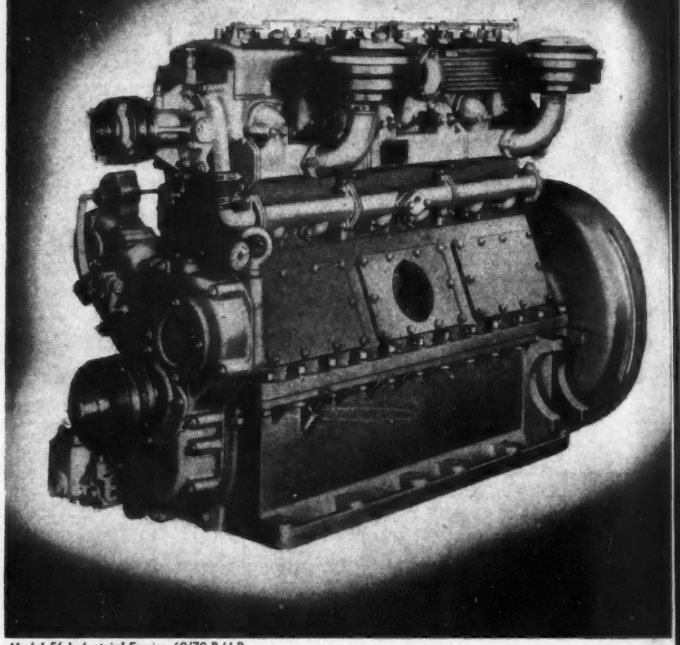

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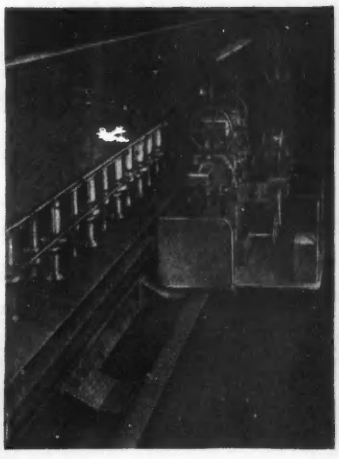

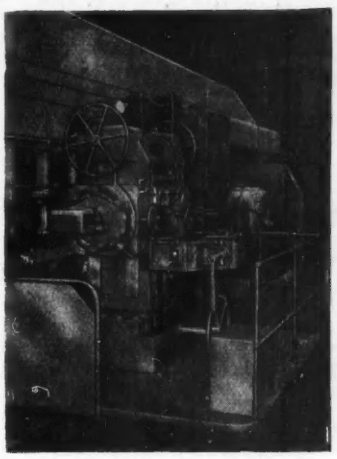

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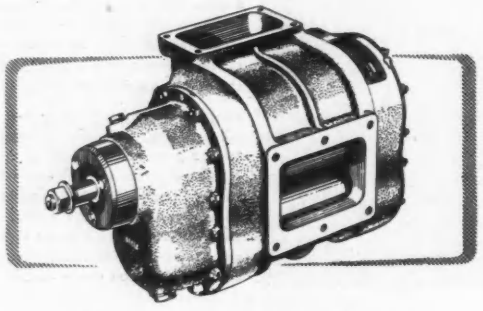

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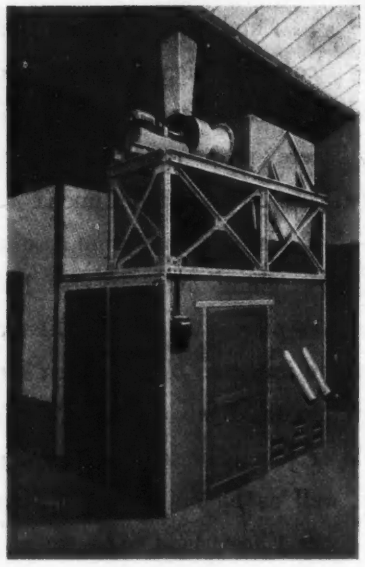

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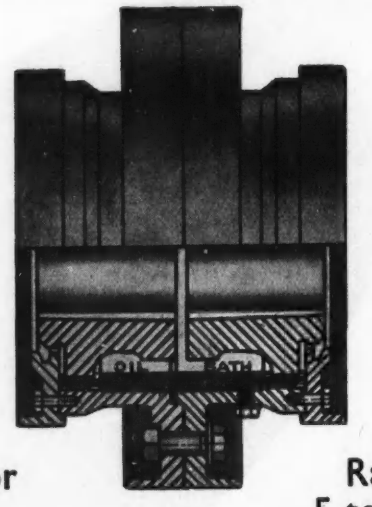

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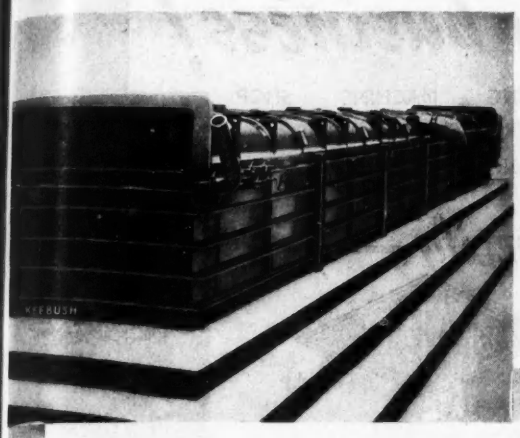

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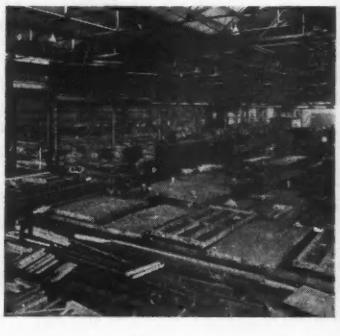

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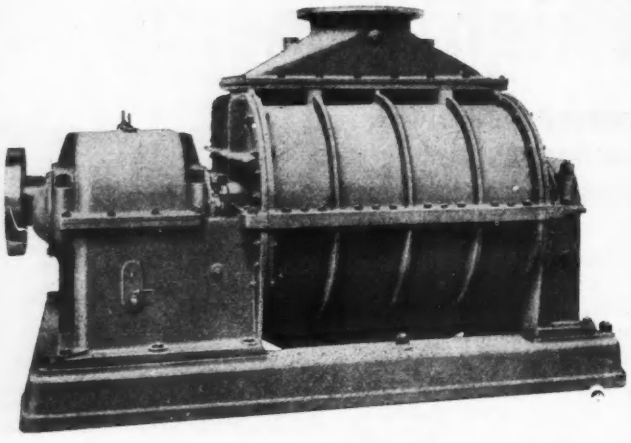

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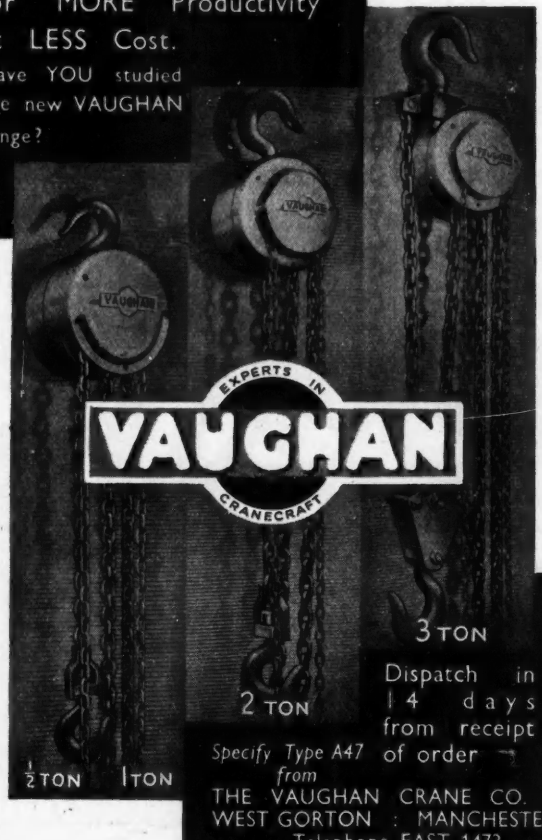

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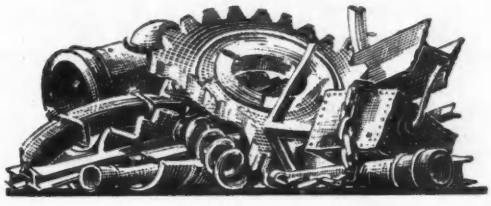

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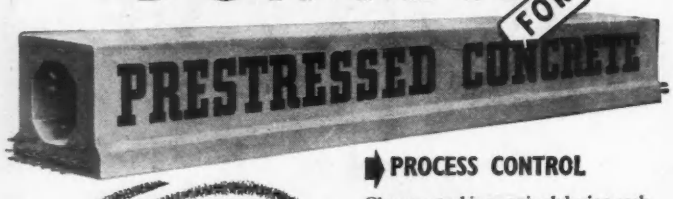

PRESTRESSED CONCRETE FACTS

THE CONCRETE STRENGTH

Concrete used by Dow-Mac for prestressing must attain a minimum compressive strength of 4,500 lb. per sq. in. before the tensioned wires are released and the prestressing forces applied. Seven days after casting this strength will increase to more than 6,000 lb. per sq. in.

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For PUMPS, VALVES, OR BEARINGS in water, or corrosive liquors, Ferobestos components offer striking advantages

FEROBESTOS Technical Plastics are inert to most industrial chemicals; resist high temperatures; can be lubricated by water or almost any liquid; are dimensionally stable, with exceptionally low moisture absorption; are easily machined and mechanically strong.

These qualities make them specially suitable for moving parts, such as rollers, gears, or bearings, that run submerged in water, dyes, or corrosive liquors; and they are now widely specified for such components as valve discs, piston and pump bucket rings, pump bearings and ram coverings, as well as for rotary compressor blades.

HEAVY HYDRAULIC MACHINERY

For heavy-duty bearings submerged in water, Ferobestos construction entirely obviates the need for complicated forced lubrication with oil.

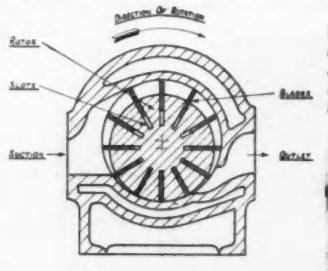
With a considerably lower coefficient of friction than any metal, these bearings save power, reduce journal wear, and generally have a much longer working life, as their load-carrying capacity is very high.

Ferobestos Technical Plastics are available in a number of grades, of varied characteristics. They are supplied in sheets, rods, and tubes; or to order, as mouldings or fully or partly machined components.

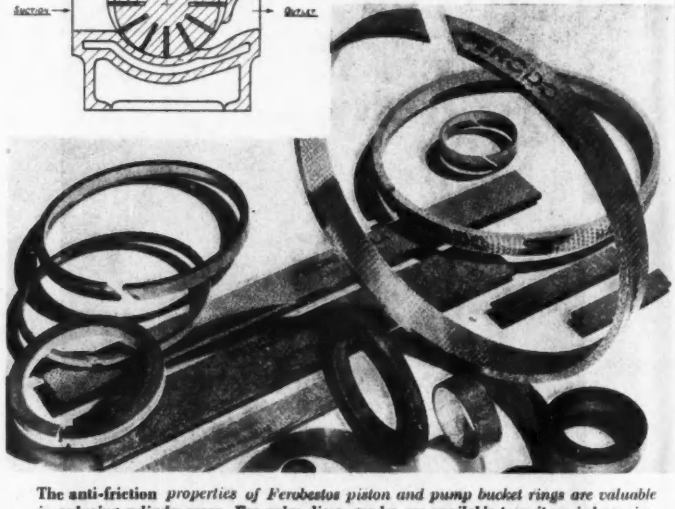
A TEST IS WORTH WHILE

So important are the advantages of Ferobestos construction in suitable cases that a test may repay its cost many times. If you can give us details of the conditions under which your present components are working—dimensions, load, speed, temperature, nature of liquid, present lubrication method, etc. — we shall be glad to advise you.

In any case we shall be pleased to send you further information on this versatile material, which may suggest uses to you. Our experience, constantly being extended, is at your service.



Rotary compressor *or exhauster, of a type in which Ferobestos vanes give excellent service. They require little or no lubrication, and work at temperatures up to 200° C. without distorting.*



The anti-friction *properties of Ferobestos piston and pump bucket rings are valuable in reducing cylinder wear. For valve discs, grades are available to suit varied requirements. Compressor blades of different sizes are also shown.*

FEROBESTOS

Technical Plastics

Made by the manufacturers of FERODO Friction Linings

Ferodo Limited

CHAPEL-EN-LE-FRITH

A Member of the Turner & Newall Organization

GILKES PUMPS

"GGG"

Self-priming pump features . . .

BELT DRIVE

MOTOR DRIVE

ENGINE DRIVE

- ROBUST CONSTRUCTION
- NO METALLIC CONTACTS
- HANDLES AIR AND WATER
- NON-PULSATING FLOW
- QUIET IN OPERATION
- FULLY SELF-PRIMING
- PUMPS FOR HEADS UP TO 700 FT — OUTPUTS UP TO 200 G.P.M.
- CONSTRUCTED IN SPECIAL METALS TO SUIT MOST LIQUIDS

★ *When eventually service is required:*

RING KENDAL 28 FOR REPAIRS WITHIN 24 HOURS

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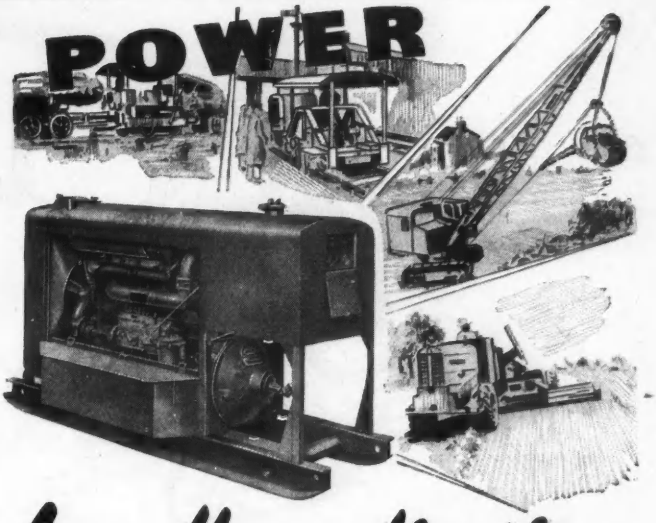
m G.23a

POWER



for all applications

WITH WORLD WIDE SERVICE

Leyland Diesel Power Units are built from standard Leyland automotive parts. So, spare parts are always available for them at any of the Leyland Service Stations throughout the world.

Rated from 55 h.p. upwards, these units are equally suitable for the majority of stationary or mobile applications, and there are special self contained installations for generating electric power. Full information will be gladly sent on request. Our Technical Department is at your service.

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Leyland

ECONOMICAL TRANSPORT

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THE MASON DRAFTING STAND

Unprecedented for excellent design, balance and structural perfection, the Mason Drafting Stand is based on the counterbalance principle to ensure complete ease in operation.

Any board adjustment may be freely obtained, from horizontal to vertical, in forward or backward position.

By depressing the back bar of the foot pedal, the assembly becomes unlocked. By using the handgrips provided at the base of the board cradle, any position can be gently and easily obtained. Firm pressure on the front bar of the foot pedal will then lock the assembly in the desired position.

The Mason Drafting Stand is designed for use with a Double Elephant, Antiquarian or Hamburg drawing board fitted with a standard drafting machine or parallel movement fitting and straightedge. A counterbalance bar is fitted to suit each assembly.

Please write or telephone for illustrated catalogue and full particulars to THE DRAWING OFFICE SERVICE DIVISION (T.E.)

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Even the most highly trained hands are useless unless they are healthy hands — hands that are free from dermatitis.

Where hands have to handle industrial irritants—soluble, cutting and lubricating oils, solvents and degreasers — Rozalex acts as a barrier against skin troubles. Rozalex, applied very easily and unnoticeable when applied, has raised output in many a factory, not only by eliminating lost time and laid-off workers, but also by eliminating the fear of trouble among the workpeople. There is a type of Rozalex effective against almost every known industrial irritant. Our technical representative is at your service. Write to Rozalex Ltd., 10 Norfolk Street, Manchester 2.

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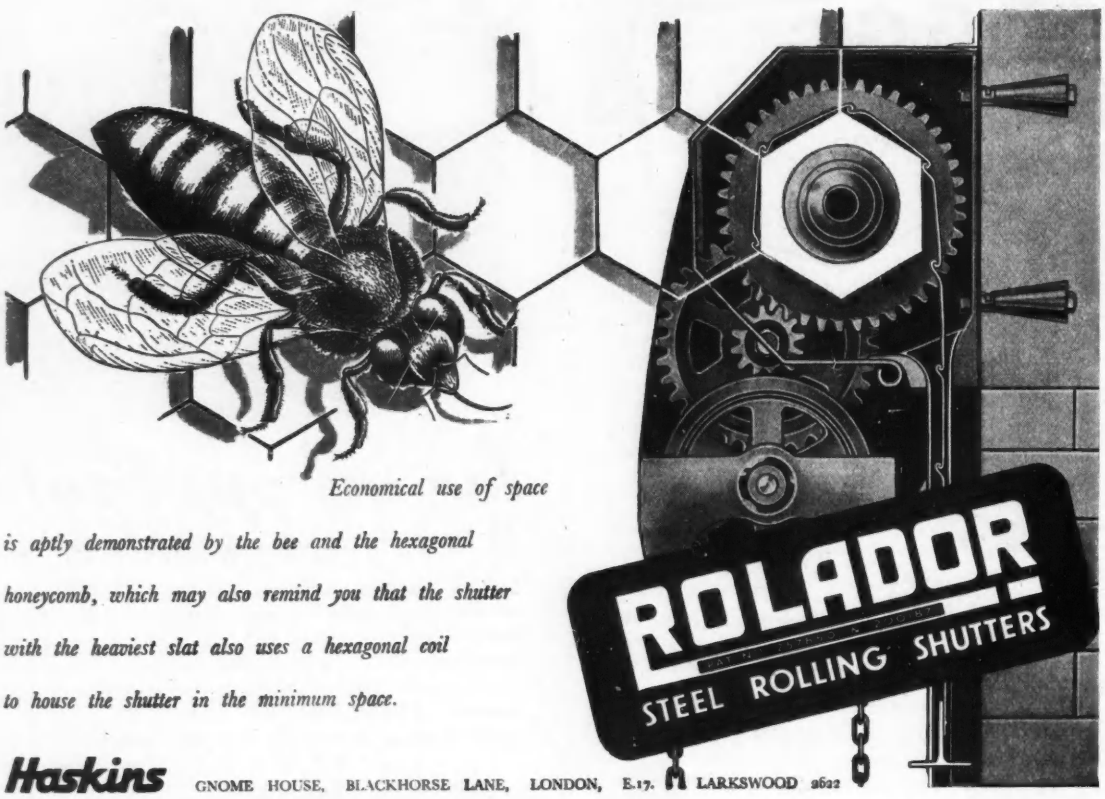

Economical use of space

is aptly demonstrated by the bee and the hexagonal honeycomb, which may also remind you that the shutter with the heaviest slat also uses a hexagonal coil to house the shutter in the minimum space.

Haskins GNOME HOUSE, BLACKHORSE LANE, LONDON, E.17. LARKSWOOD 2622

DEAD WEIGHT PRESSURE GAUGE TESTER

- **Standard range 10 to 5,000 P.S.I.**
- **Combines a high and low pressure system with rapid change-over.**
- **Four adaptors $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$ and $\frac{1}{2}$ B.S.P. are provided.**

Also available:
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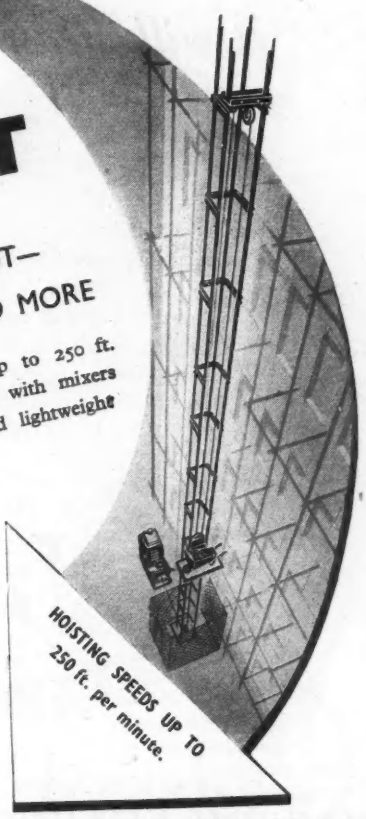
WHETHER YOU HIRE DIRECT FROM US OR NOT—
MAKE SURE THE HOIST IS AN **ACE**—IT COSTS NO MORE

The ACE range includes electric, petrol and diesel driven hoists, with speeds up to 250 ft. per minute. There are 5/50 cwt. Platform Hoists, Concrete Elevating Plants to work with mixers from 7/5 to 21/14 size, Mobile Platform Hoists, Shaft Hoists, Haulage Winches and lightweight Portable Winches. Bottom limits for platform control fitted if required.

SEND FOR ADDRESS OF NEAREST DEPOT



HOISTING SPEEDS UP TO 250 ft. per minute.

use ACE *hoists*

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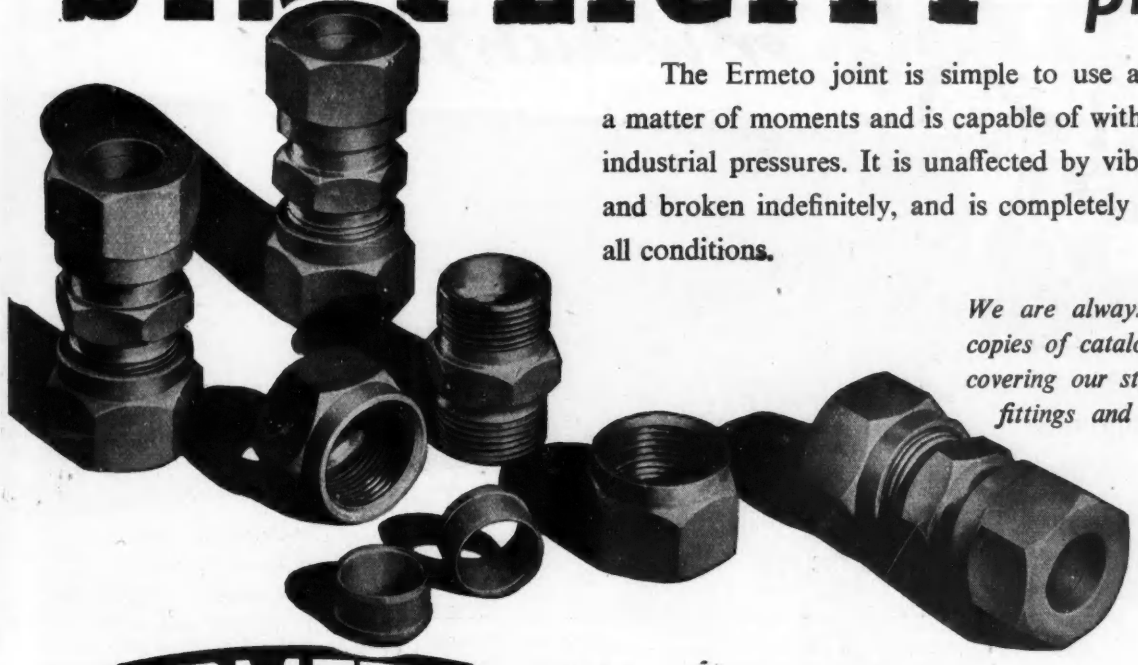
SIMPLICITY *plus . . .*



The Ermeto joint is simple to use and can be made in a matter of moments and is capable of withstanding the highest industrial pressures. It is unaffected by vibration, can be made and broken indefinitely, and is completely pressure-tight under all conditions.

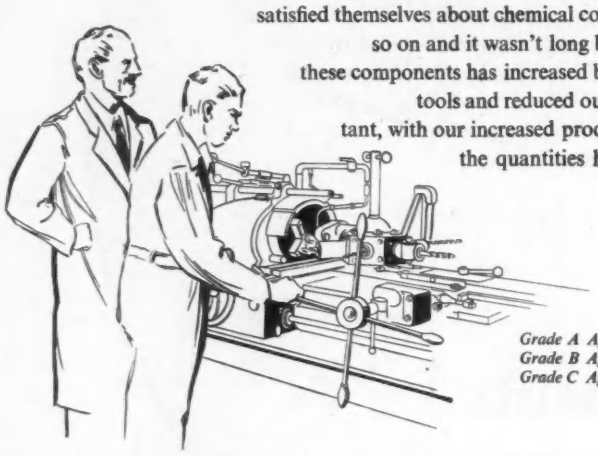
We are always pleased to forward copies of catalogues, price lists, etc., covering our standard ranges of pipe fittings and high pressure valves.

ERMETO *SELF-SEAL COUPLINGS*

BRITISH ERMETO CORPORATION LTD., MAIDENHEAD, BERKS

"It will mean a saving of 30% on machining time with 'Telfos'"

"It has been proved over and over again. For years we used ordinary Rolled Phosphor Bronze on this job — then we heard about 'Telfos' Bronze and learned that it was a similar metal. Our technical people soon satisfied themselves about chemical composition, physical properties and so on and it wasn't long before we changed over. Since then our output of these components has increased by nearly one third. We have saved on tools and reduced our production costs considerably. What is more important, with our increased production we are now able to give our customer the quantities he requires. I suggest you get in touch with Cliffords."



Grade A App. 95% Copper, 5% Tin, ·1% Phos.
Grade B App. 92% Copper, 8% Tin, ·1% Phos.
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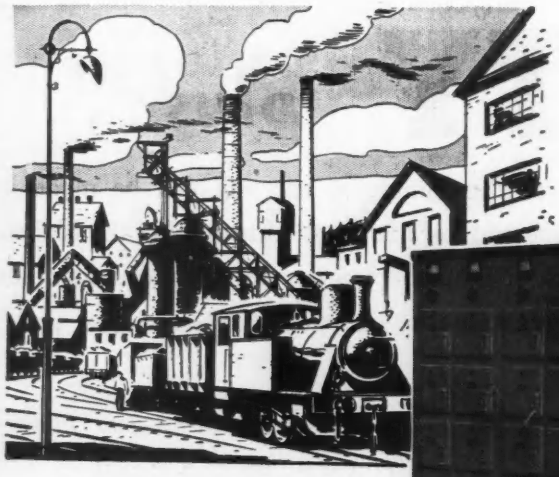
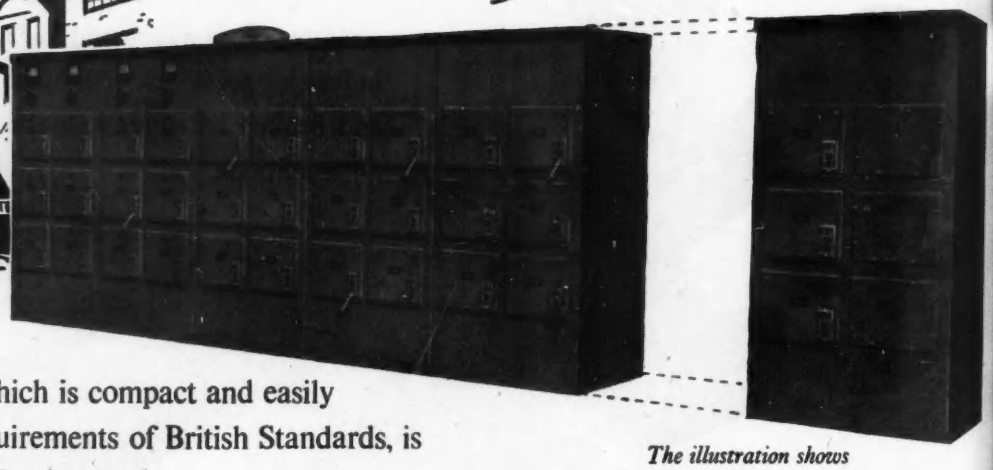


For public supply or industry...



BRUSH high rupturing capacity fuse Switchgear which is compact and easily extensible, covering the requirements of British Standards, is outstanding in design and pleasing to the eye

The illustration shows switchboard for 400/230 volt service equipped with 300 ampere T.P. and T.P. and N. fuse switches

the best answer is **BRUSH**

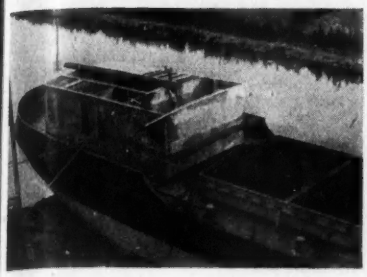
15·27

The Brush Electrical Engineering Co. Ltd., Loughborough, England

London. Birmingham. Cardiff. Manchester. Leeds. Newcastle. Glasgow. Bristol. Sheffield

Take a barge...

The entire deckhouse of the "Marbury" is built of aluminium alloy, 'Kynal' M.39/2, fully heat-treated, manufactured by the Metals Division of I.C.I. The saving in weight enables the barge to carry a greater pay load.



Weighing 350 tons, the 'Marbury' was built by Isaac Pimblott & Co. Ltd. of Weaver Shipyard, Northwich, to carry soda ash.

There are many other ways of using aluminium alloys in industry to save weight and maintenance charges, and to increase durability. Our Technical and Development Departments have had wide experience of the applications of aluminium and their knowledge is freely available to architects, engineers, designers and builders.

'KYNAL' AND 'KYNALCORE' ALUMINIUM ALLOYS

IMPERIAL CHEMICAL INDUSTRIES LIMITED, LONDON, S.W.1

ICI

M.178a

PAXMAN POWERED BRITISH DIESEL LOCOMOTIVES

400 b.h.p. Diesel-Electric Shunting Locomotive powered by Paxman Mark 12 RPH. 12-cylinder engine.

British Railways (London Midland Region) 827 b.h.p. Mixed Traffic Diesel Electric Locomotive. Motive power is provided by a turbo-charged Paxman Mark 16 RPH. 16-cylinder engine.

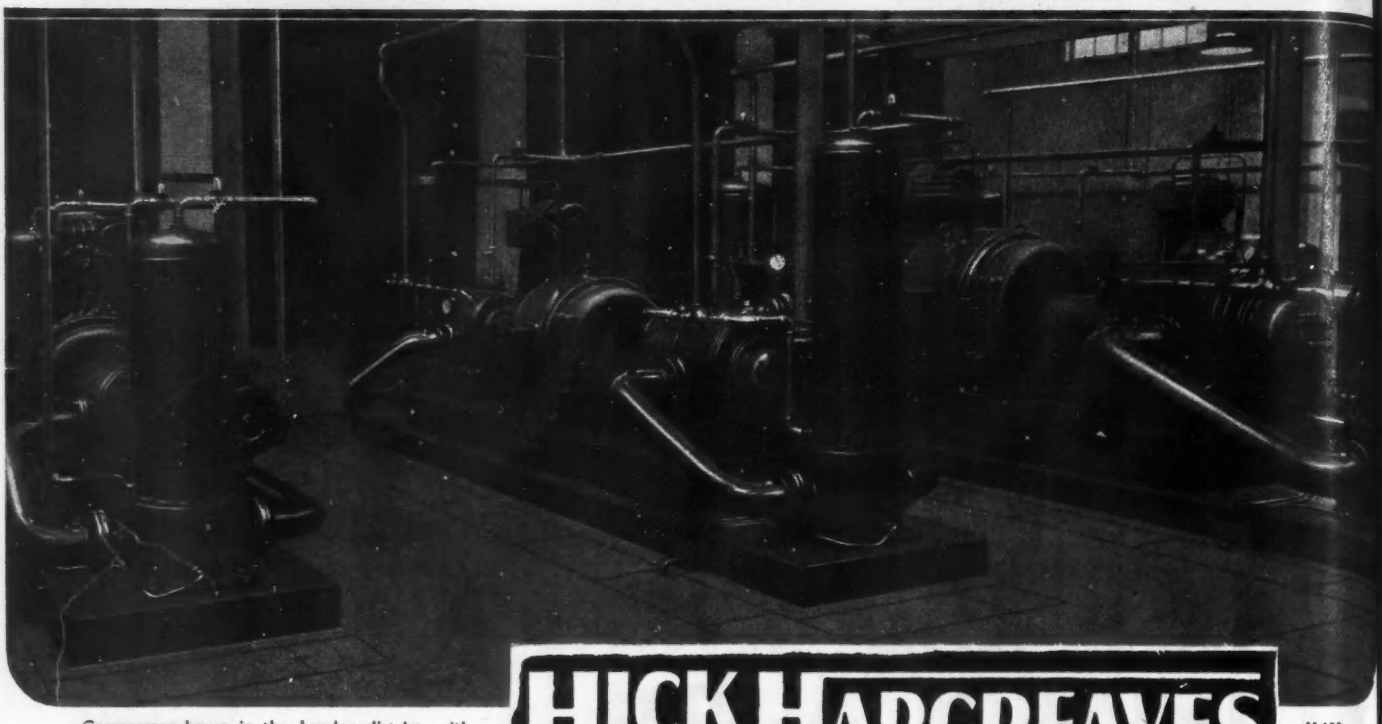
These represent but a few of the Modern Diesel Locomotives and Rail Cars throughout the world where a Paxman engine is the power unit ; so please write if you are interested and we will tell you more.

Right—British Railways (Southern Region) 500 b.h.p. Paxman powered Diesel Mechanical Shunting Locomotive.

DAVEY, PAXMAN & CO. LTD., COLCHESTER

(ASSOCIATED WITH RUSTON & HORNSBY LTD., LINCOLN)

ROTARY COMPRESSORS

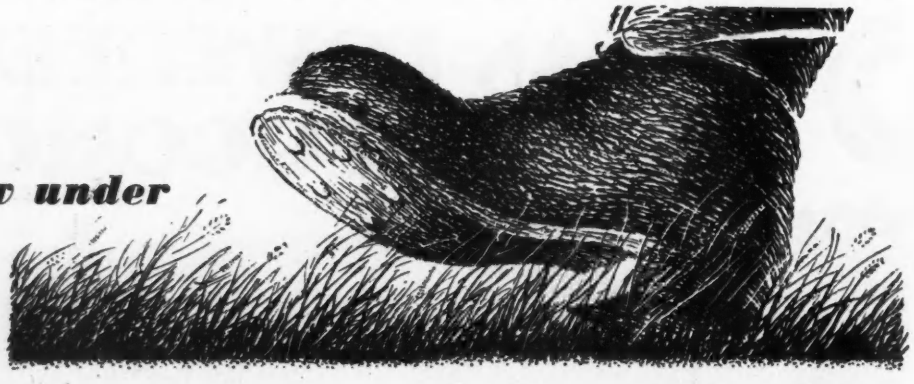


Compressor house in the London district, with 4 Hick Hargreaves two-stage rotary compressors. Capacity over 3,000 c.f.m. Main Contractors : G. N. Haden & Sons, Limited.

HICK HARGREAVES
AND COMPANY LTD BOLTON

H.122

how not to let the grass grow under your feet . . .



Improving the breed of grasses and clover with the help of refrigeration. Part of the special 500 cu. ft. Prestcold cold room at the Welsh Plant Breeding Station near Aberystwyth.

When seed-time comes in 1960, fields being put down to grass and clover may well be sown—and sown successfully—with seed harvested during the first half of the century.

This may sound surprising when you consider that seed normally loses its power of germination after a year or so. But then refrigeration *is* surprising.

At Aberystwyth, for example, the finest strains of grass and clover seed are being carefully selected and stored for use in years when current seed is poor. And it is being done with the help of Prestcold Refrigeration, which by consistent controlled coldness year after year holds the germinating power of the seed in suspension. When the bad year comes, good seed will still be available: the grazing will still be rich, the hay crop heavy. This is but one example of the many ways in which Prestcold Refrigeration is assisting agriculture—and hence the National larder. The same assistance is equally afforded to industry, science and commerce. By providing new answers to old problems, Prestcold can both stop the grass growing under your feet or *help* it to grow. Your inquiries are welcomed, either through your local Prestcold Distributor or direct.

PRESTCOLD REFRIGERATION
for every purpose

COMMERCIAL · INDUSTRIAL · SCIENTIFIC · AGRICULTURAL · DOMESTIC

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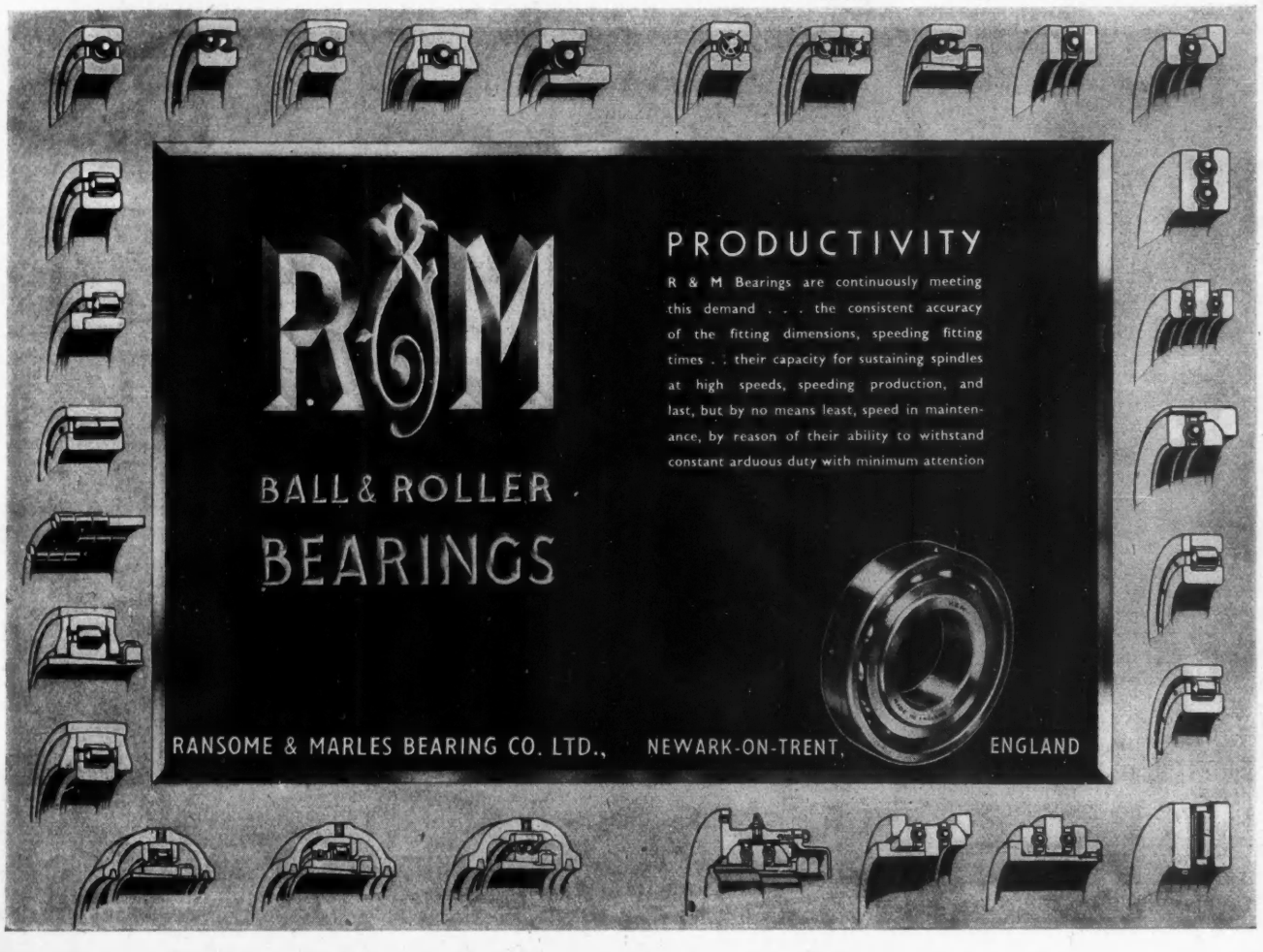
We are used to difficult casting jobs at APV. Look at this grill, for instance, cast in aluminium alloy with webs $\frac{1}{8}$-inch thick and up to 23 inches long, and yet every web solid and sound. APV are large users as well as producers of aluminium castings and their foundries have for years produced to the most exacting requirements under the technical control of the APV Metallurgical Laboratories.

APV *ALUMINIUM CASTINGS*

THE A.P.V. COMPANY LTD., WANDSWORTH PARK, LONDON, S.W.18 TEL: VANDYKE 4492 (12 lines)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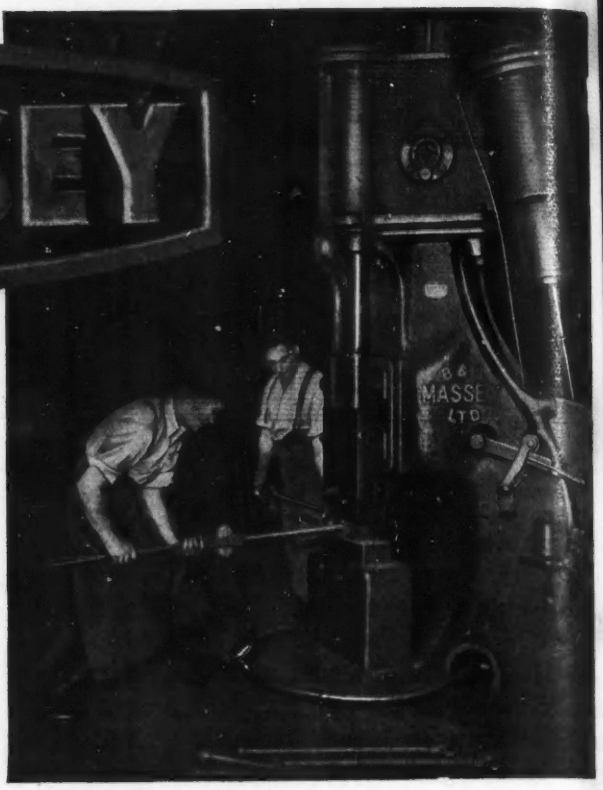
BALL & ROLLER
BEARINGS
PRODUCTIVITY
R & M Bearings are continuously meeting this demand . . . the consistent accuracy of the fitting dimensions, speeding fitting times . . their capacity for sustaining spindles at high speeds, speeding production, and last, but by no means least, speed in maintenance, by reason of their ability to withstand constant arduous duty with minimum attention
RANSOME & MARLES BEARING CO. LTD., NEWARK-ON-TRENT, ENGLAND

MASSEY



PNEUMATIC POWER HAMMERS

WITH SLIDES — SIZES: 1 CWT. TO 1 TON

The control of a Massey Pneumatic Power Hammer is exceptionally sensitive and responsive. Not only can light or heavy automatic blows be struck as desired, but also definite "single" blows, for each of which a separate movement of the controlling lever is required, so that there is no fear of a second blow following unintentionally.

The economy secured by the installation of Massey Pneumatic Power Hammers in place of steam hammers is such that the capital expenditure is quickly recovered. Actual examples can be quoted of running costs being reduced to one-sixth or less.

A Massey Pneumatic Power Hammer is cleaner and more convenient—there is no water to drip on to the work, and no waiting for the steam pressure to be raised in a boiler.

Ask for Leaflet 4800H.

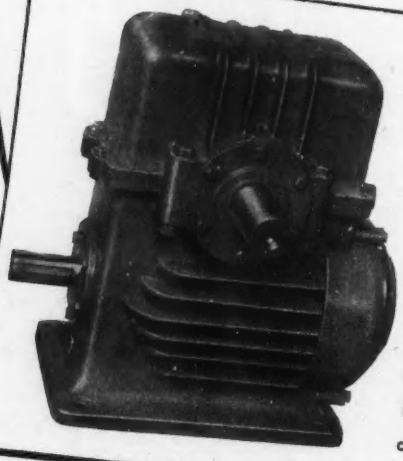
B&S. MASSEY LTD
OPENSHAW. MANCHESTER, ENGLAND.

OPPI-GEAR

OPPERMANS of NEWBURY

We manufacture this type of geared motor in six sizes for H.P.s between ¼ and 15 with output speed between 375 and 12 r.p.m. We can supply any make of motor with any type of enclosure, or we can fit your motors provided they are of the flange fixing pattern. This type of geared motor is also available with a vertical output shaft for driving stirrers, mixers, agitators, etc.

May we send you our catalogue?



This illustration shows a worm geared speed reducer which we produce with or without fan cooling in a range of sizes from 1¼" to 9" gear centres; standard ratios between 10-1 and 60-1 are available in each size. Ratios outside this range can also be supplied.

For a completely trouble free life under the most exacting conditions, you can depend on either of these two gear boxes and for that matter on any of the other many different types of speed reducers that we produce.

OPPERMAN OPPI-GEAR GEARS LTD.
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The range includes: Broaches, Milling Cutters, Twist Drills, Centre Drills, Reamers, Adjustable Reamers, Drill-Reamers, Cut Thread and Ground Thread Taps, Tap Wrenches, Dies, Die Stocks, Dieheads, Tapping Attachments, Sleeves and Sockets, Quick-Change Drill Chucks, Lathe Chucks, Machine Vices, Coolant Pumps, Hacksaw Blades, Files and Rasps, etc.

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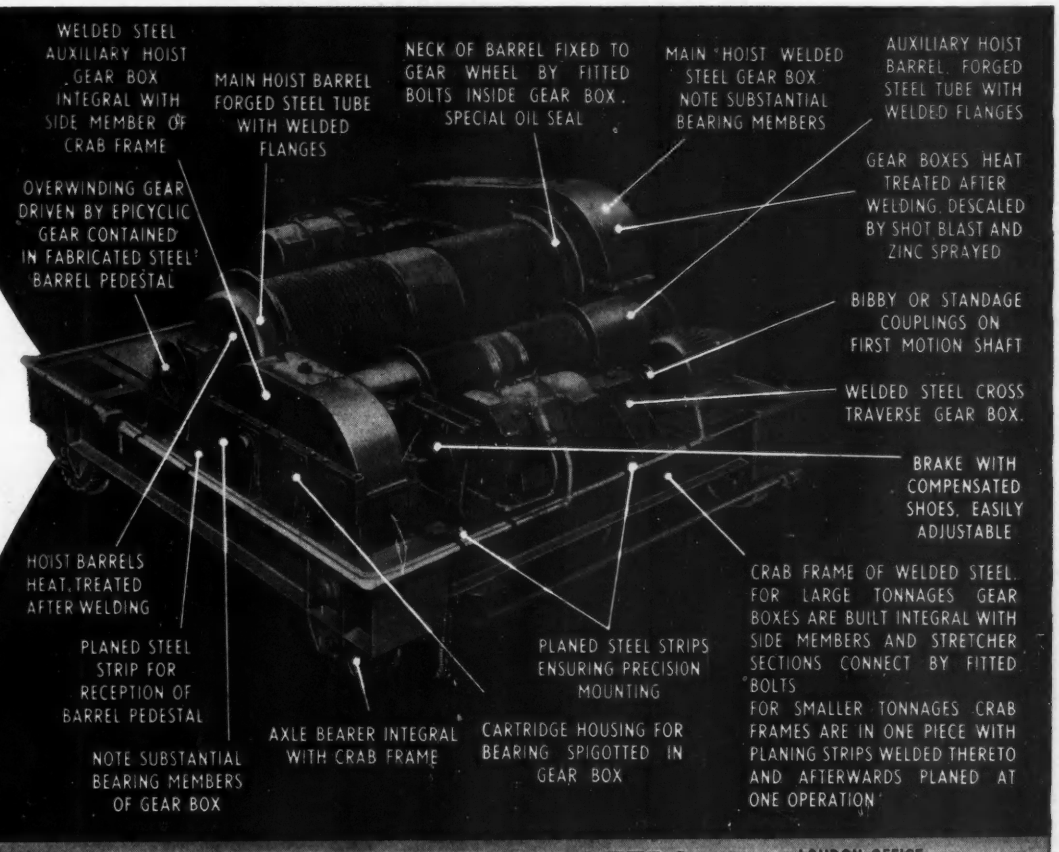
ABSOLUTELY DEPENDABLE

Salient features of BOOTH CRANES


WELDED STEEL AUXILIARY HOIST GEAR BOX INTEGRAL WITH SIDE MEMBER OF CRAB FRAME
MAIN HOIST BARREL FORGED STEEL TUBE WITH WELDED FLANGES
NECK OF BARREL FIXED TO GEAR WHEEL BY FITTED BOLTS INSIDE GEAR BOX. SPECIAL OIL SEAL
MAIN HOIST WELDED STEEL GEAR BOX. NOTE SUBSTANTIAL BEARING MEMBERS
AUXILIARY HOIST BARREL. FORGED STEEL TUBE WITH WELDED FLANGES
OVERWINDING GEAR DRIVEN BY EPICYCLIC GEAR CONTAINED IN FABRICATED STEEL BARREL PEDESTAL
GEAR BOXES HEAT TREATED AFTER WELDING. DESCALED BY SHOT BLAST AND ZINC SPRAYED
BIBBY OR STANDAGE COUPLINGS ON FIRST MOTION SHAFT
WELDED STEEL CROSS TRAVERSE GEAR BOX.
BRAKE WITH COMPENSATED SHOES, EASILY ADJUSTABLE
HOIST BARRELS HEAT TREATED AFTER WELDING
PLANED STEEL STRIP FOR RECEPTION OF BARREL PEDESTAL
NOTE SUBSTANTIAL BEARING MEMBERS OF GEAR BOX
AXLE BEARER INTEGRAL WITH CRAB FRAME
CARTRIDGE HOUSING FOR BEARING SPIGOTTED IN GEAR BOX
PLANED STEEL STRIPS ENSURING PRECISION MOUNTING
CRAB FRAME OF WELDED STEEL. FOR LARGE TONNAGES GEAR BOXES ARE BUILT INTEGRAL WITH SIDE MEMBERS AND STRETCHER SECTIONS CONNECT BY FITTED BOLTS
FOR SMALLER TONNAGES CRAB FRAMES ARE IN ONE PIECE WITH PLANING STRIPS WELDED THERETO AND AFTERWARDS PLANED AT ONE OPERATION

PHONE: PUDSEY 3168
GRAMS: CRANES RODLEY

JOSEPH BOOTH & BROS., RODLEY, LEEDS
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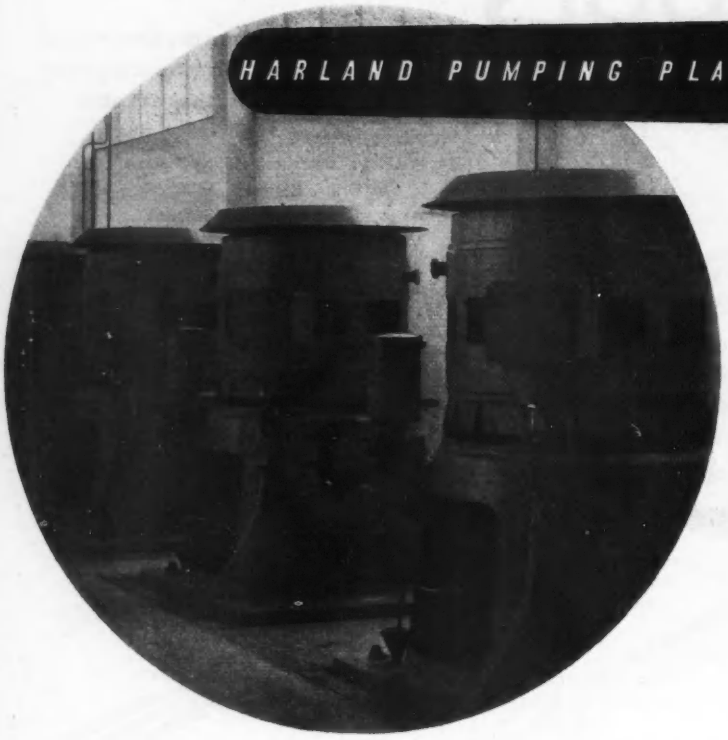
JB 11

HARLAND PUMPING PLANT FOR THE STEEL INDUSTRY



For nearly half a century The Harland Engineering Co. have designed, manufactured and installed Pumping Plant specially suited to the requirements of the Iron and Steel Industry.

The illustration shows some of the Harland vertically suspended pumpsets installed at the Abbey Works for handling storm and mill service water for The Steel Company of Wales.

The standard range driven by Harland motors covers all duties up to 20,000 gallons per minute with heads up to 170 feet.

THE HARLAND ENGINEERING COMPANY LIMITED.
WORKS: ALLOA, SCOTLAND. 'PHONE ALLOA 390. LONDON OFFICE: HARLAND HOUSE, 20 PARK STREET, W.1. 'PHONE GROSVENOR 1221. ALSO AT: BRISTOL, GLASGOW LEEDS, MANCHESTER, NEWCASTLE-ON-TYNE AND NOTTINGHAM.

EDMUND NUTTALL

SONS & CO. (LONDON) LTD.

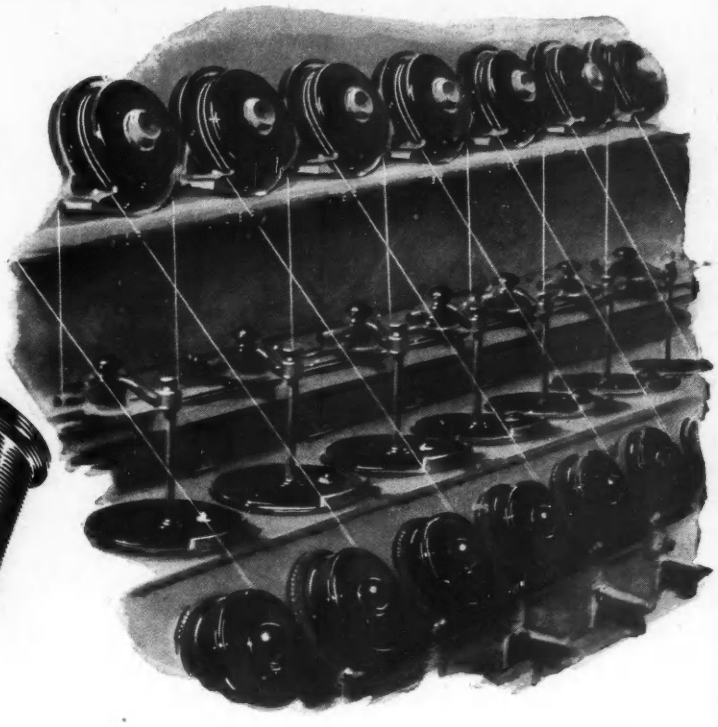
Civil Engineering Contractors

22 GROSVENOR GARDENS, LONDON, S.W.1

E.N.50

NORAL FORGINGS

Spinning threads at 8,000 revolutions a minute...



Spin pot for rayon yarn manufacture forged in pure aluminium.

propelling a plane at 400 miles an hour...

Air screw blade forged in Noral 17S alloy.

Two examples typifying the greatly contrasted uses of Noral forgings and illustrating, in differing degrees, the strength, toughness and durability of aluminium and its alloys. These and many other advantages make Noral alloys specially suitable for light and heavy engineering purposes.

Northern Aluminium
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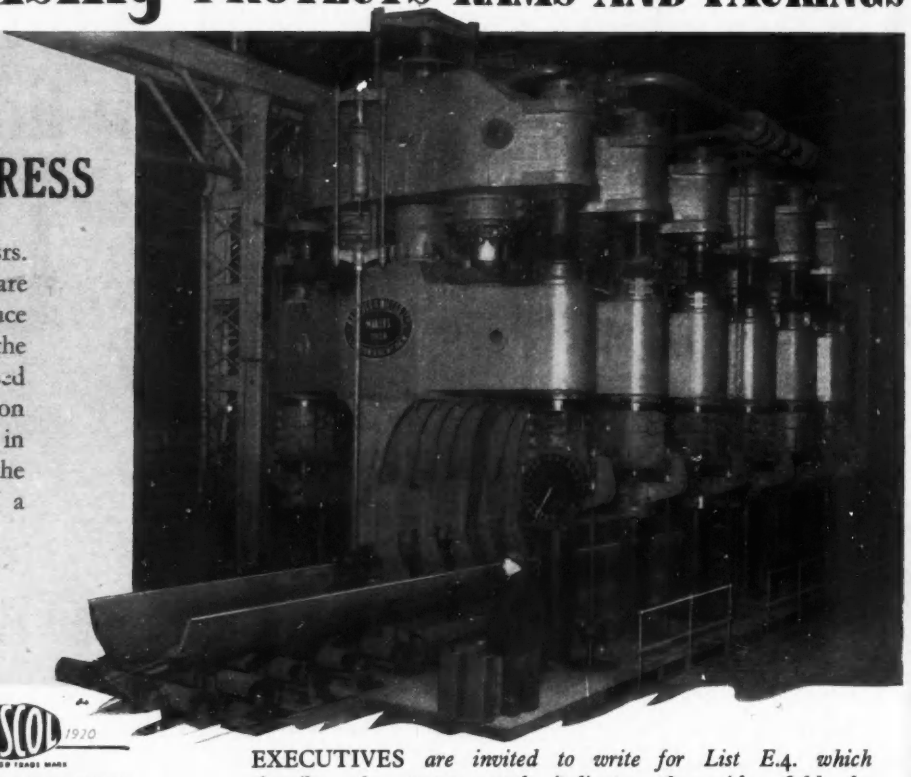

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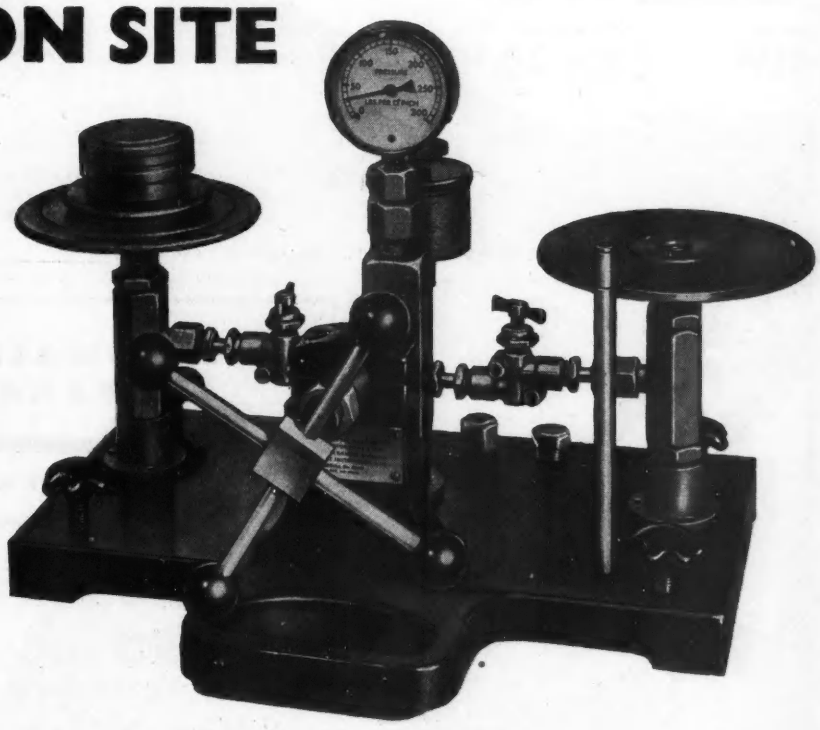

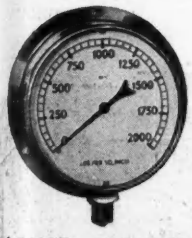

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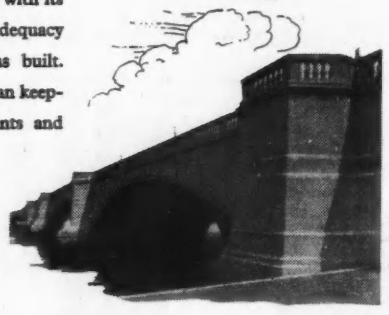

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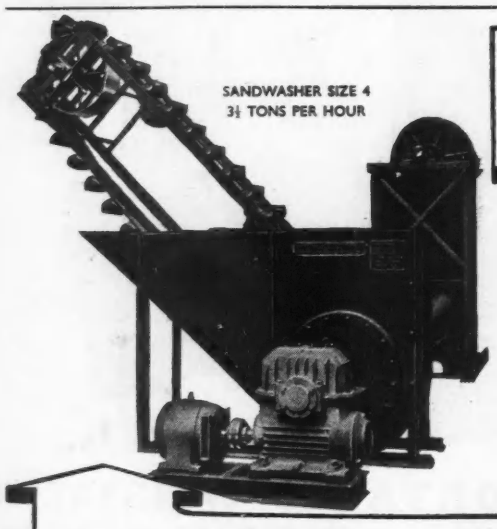

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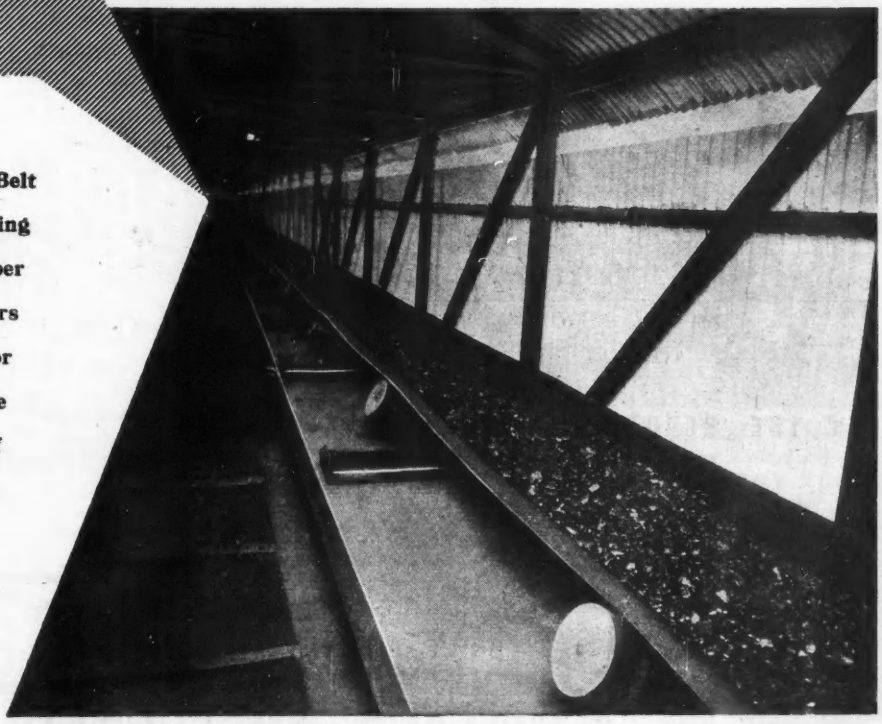

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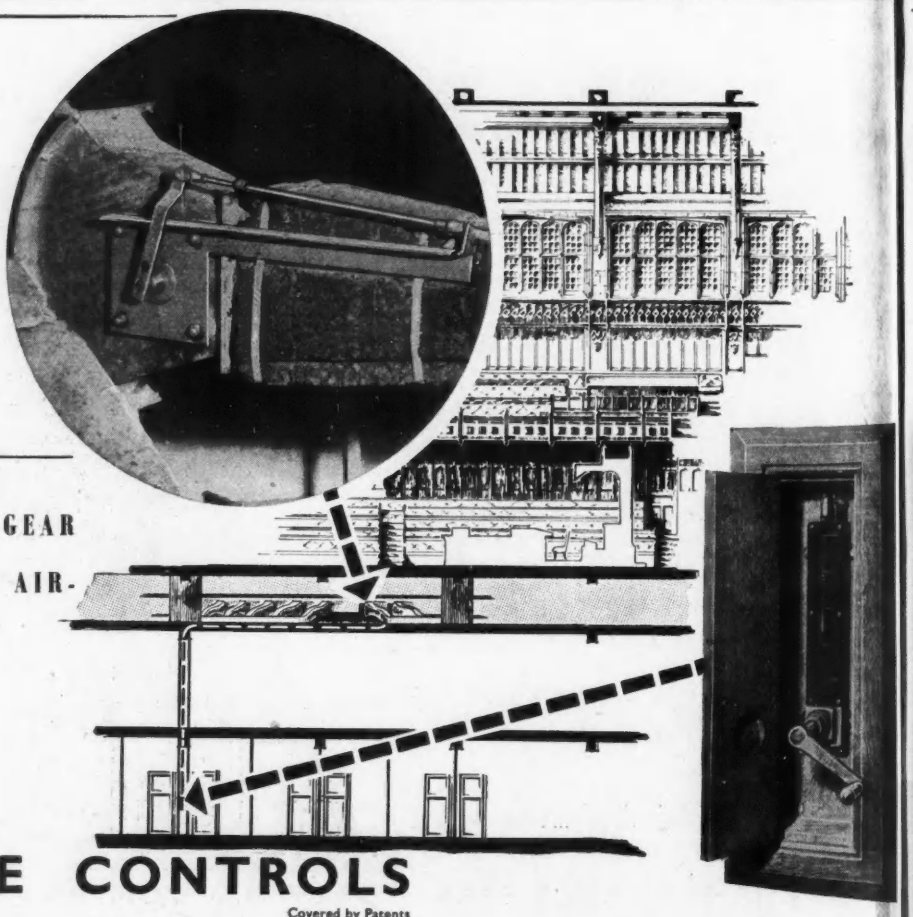

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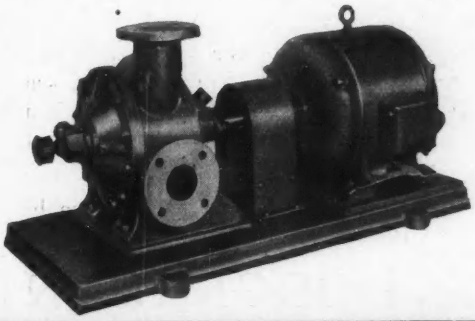

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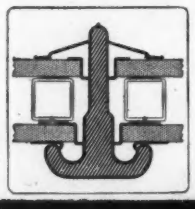
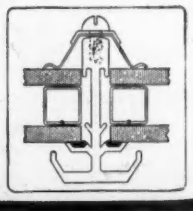


'Eclipse' Lead Covered Double Glazing Bar.



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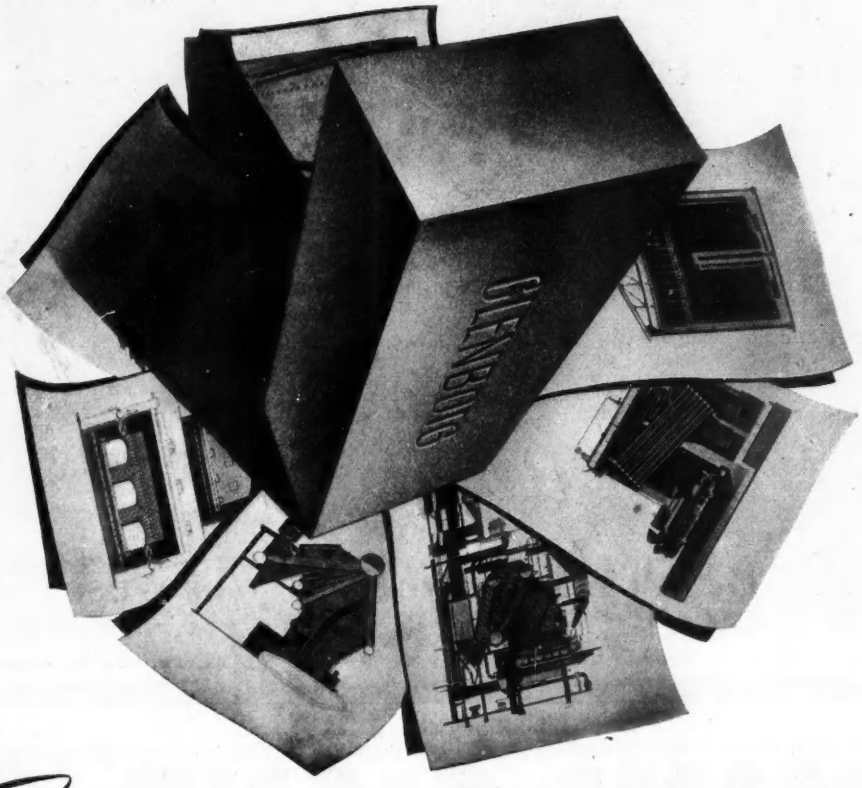

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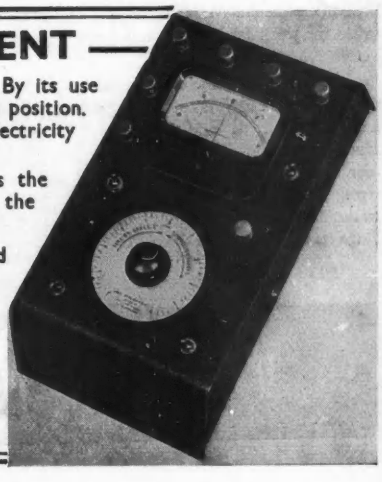

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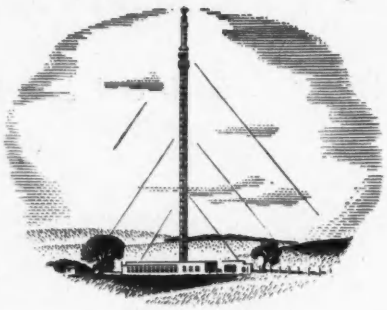

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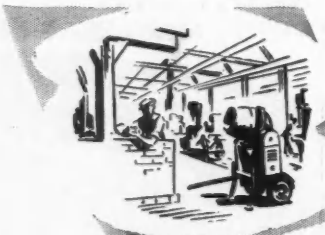

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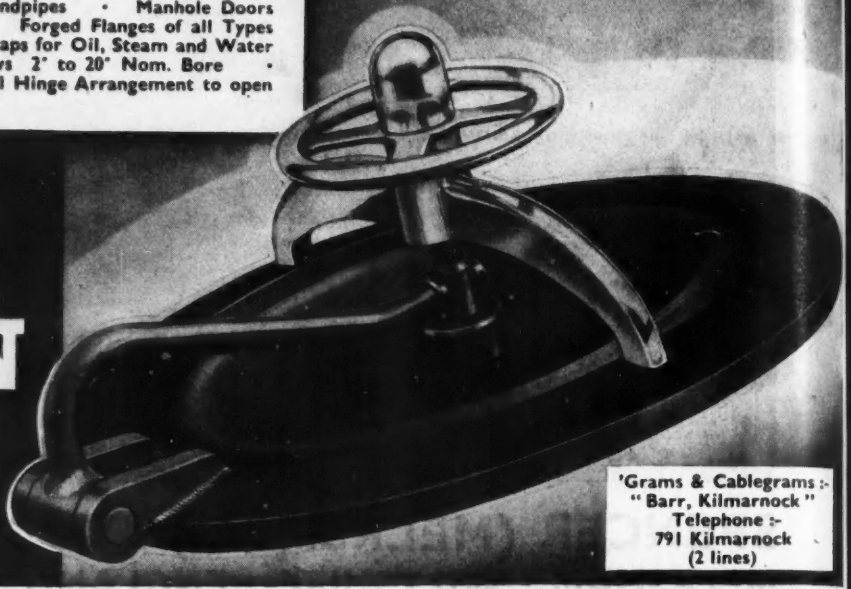

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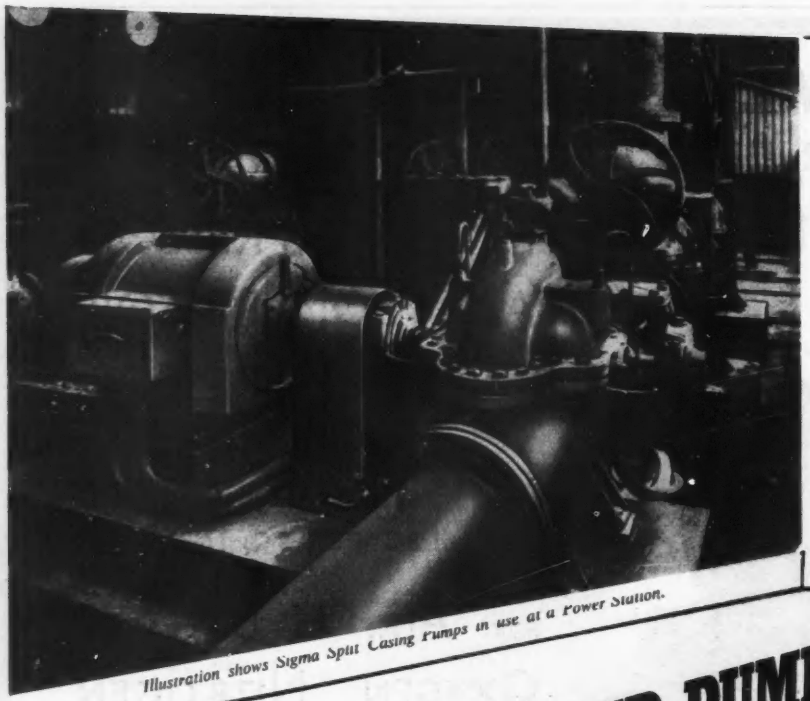

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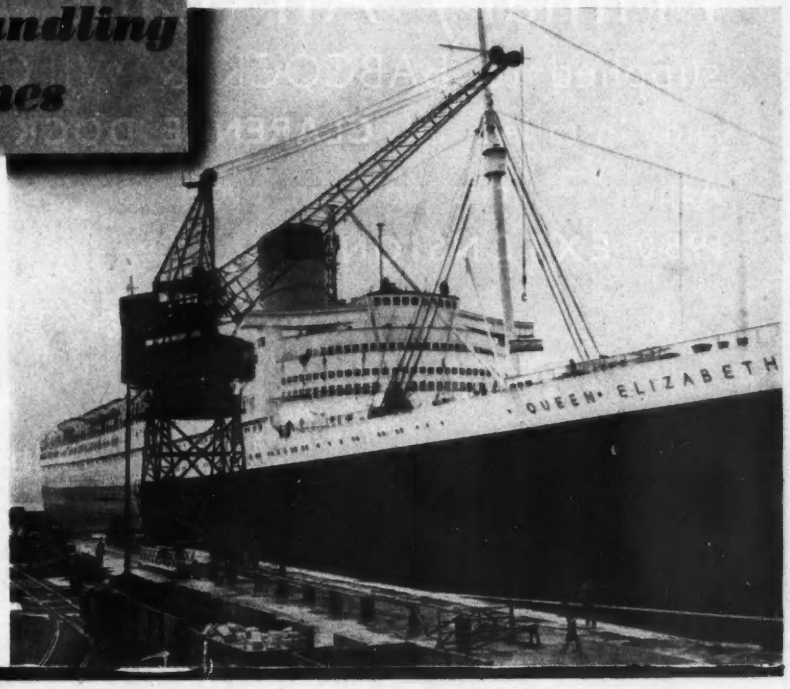

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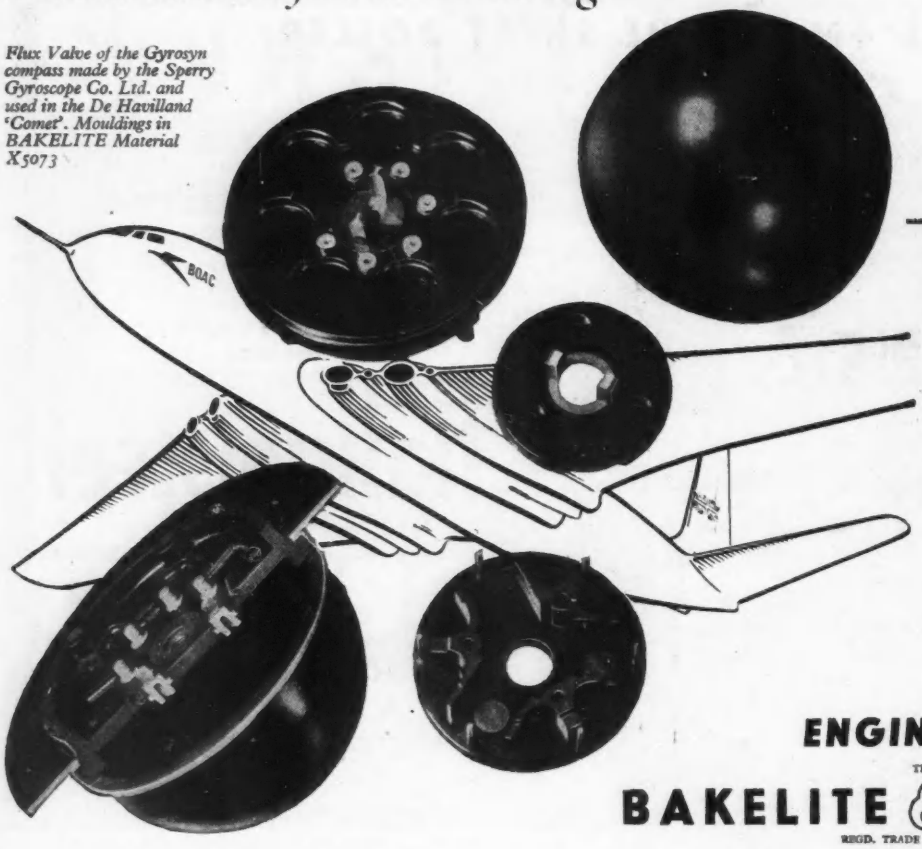

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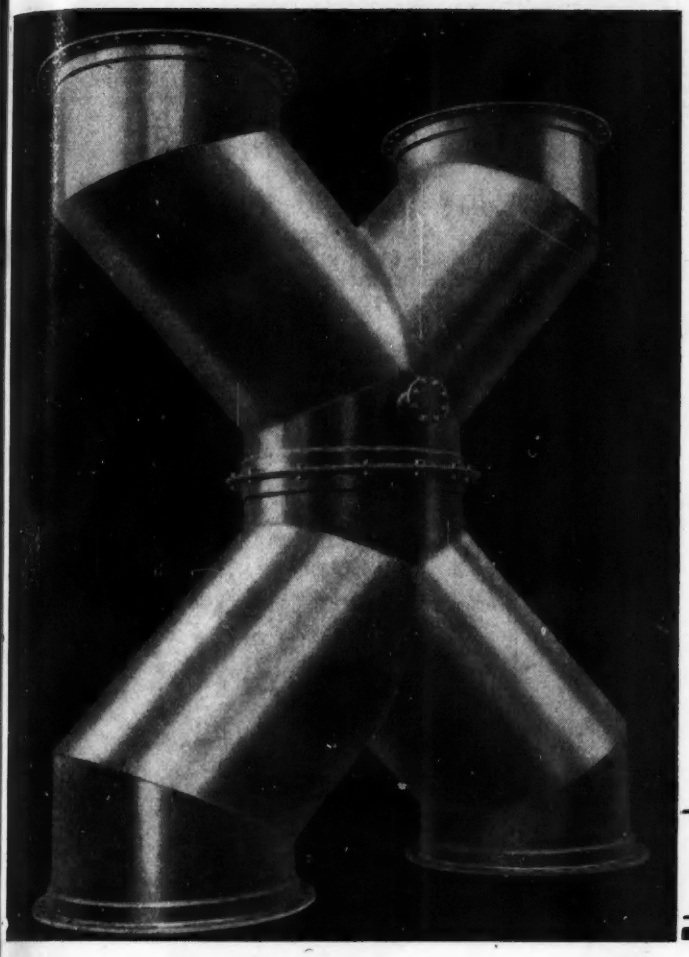

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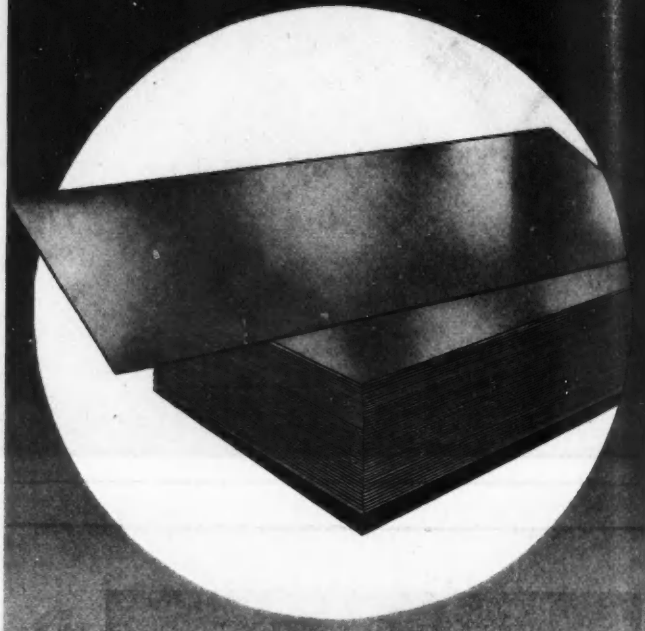

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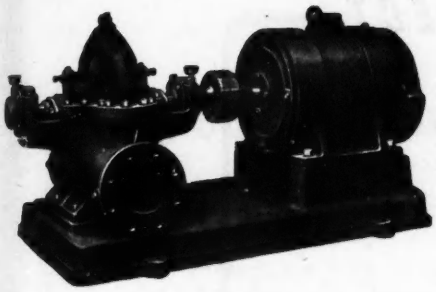

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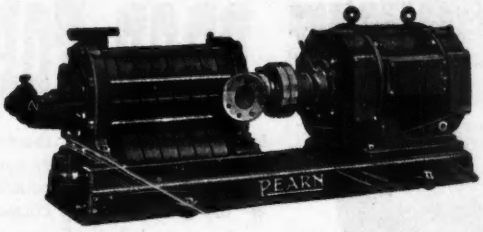

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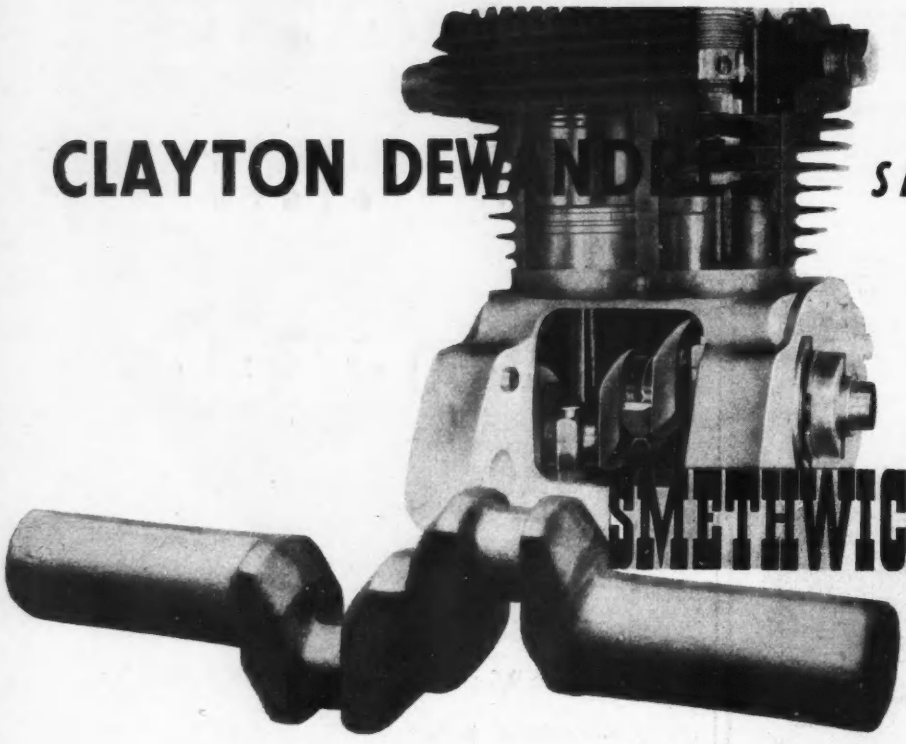

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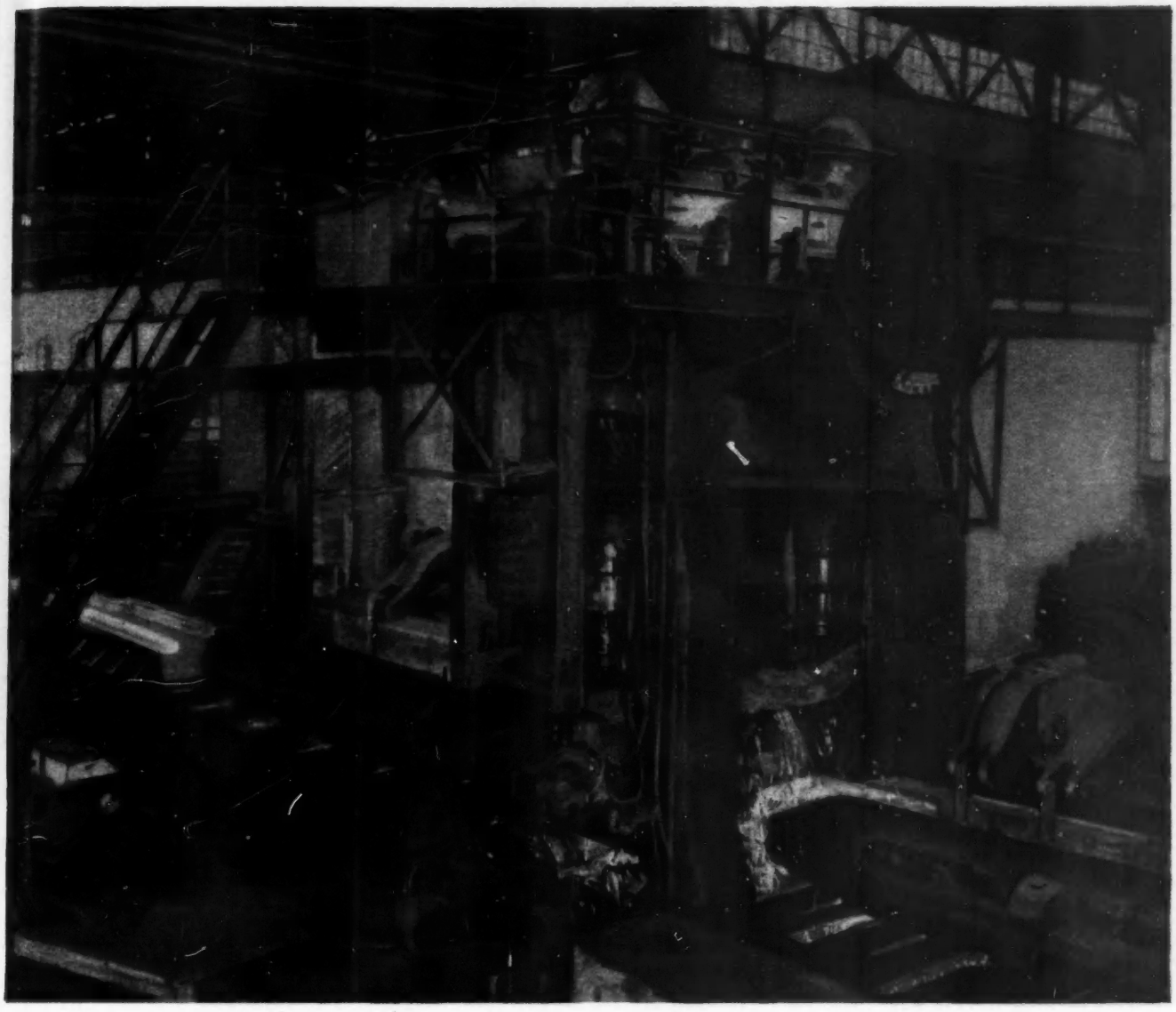

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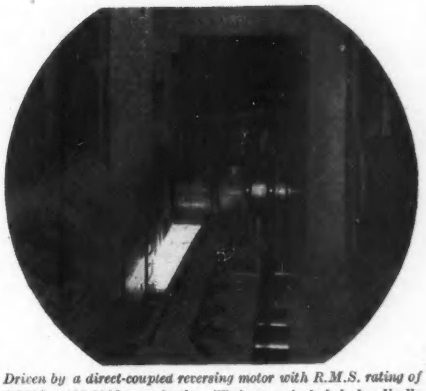
Rolling 800,000 tons of steel A YEAR

THIS 42 in. REVERSING BLOOMING MILL at work in the Templeborough Works of Steel, Peech & Tozer, Branch of United Steel Companies, Ltd., and reproduced here from the original painting by Grace Wheatley, is a big factor in Britain's industrial fortune. Producing blooms from ingots weighing 3 to 4½ tons it regularly delivers outputs of the order of 1,000 tons per shift. In the year ended 30th June, 1949, it rolled 800,000 ingot tons, a record for any British Blooming Mill.

The mill has worked continuously since its installation five years ago, when it replaced a similar though smaller Davy-United Mill which has also given many years of uninterrupted service.



Driven by a direct-coupled reversing motor with R.M.S. rating of 6,500 h.p. (15,000 h.p. peak), the mill's features include hydraulically operated manipulators, two-motor screwdown with Ward-Leonard control giving a screwing speed of 220 in. per minute, white metal roll neck bearings, pressure grease lubricated, and hydraulic roll balance.

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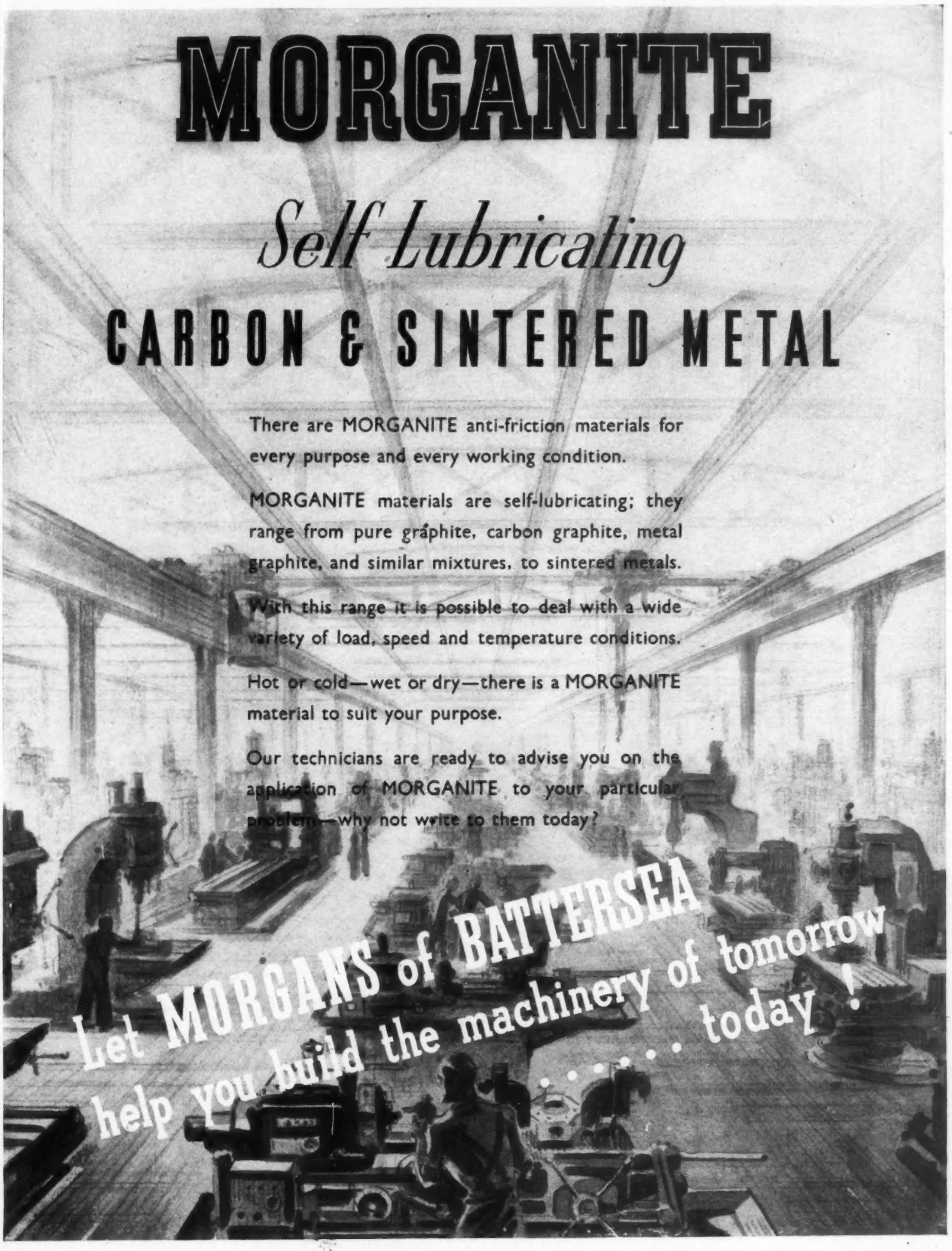

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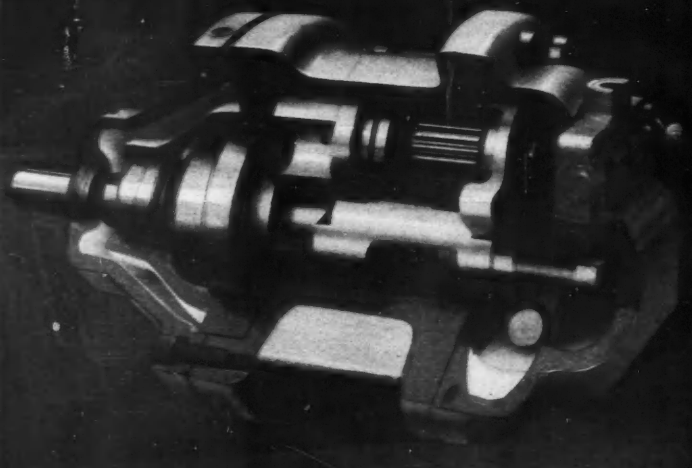

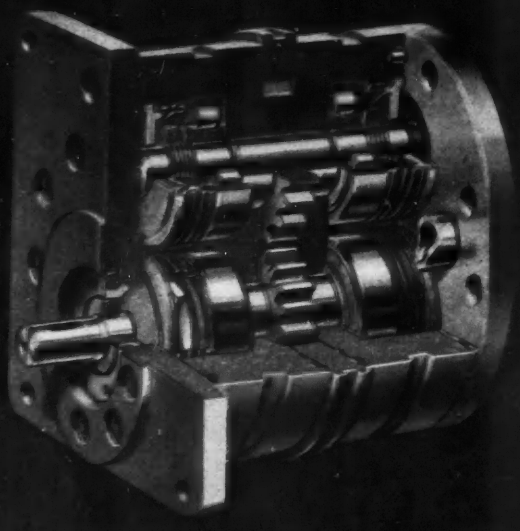

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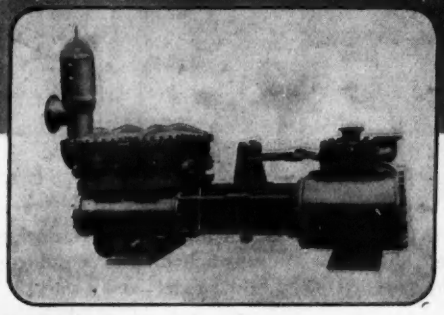

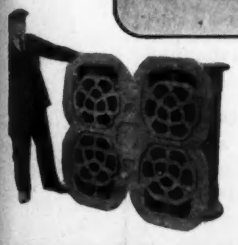

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Left Indication of size of this 30-cwt. gunmetal casting.

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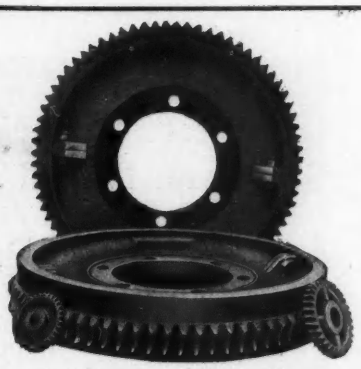

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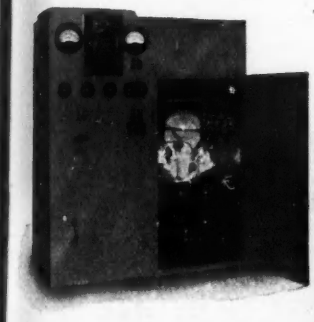

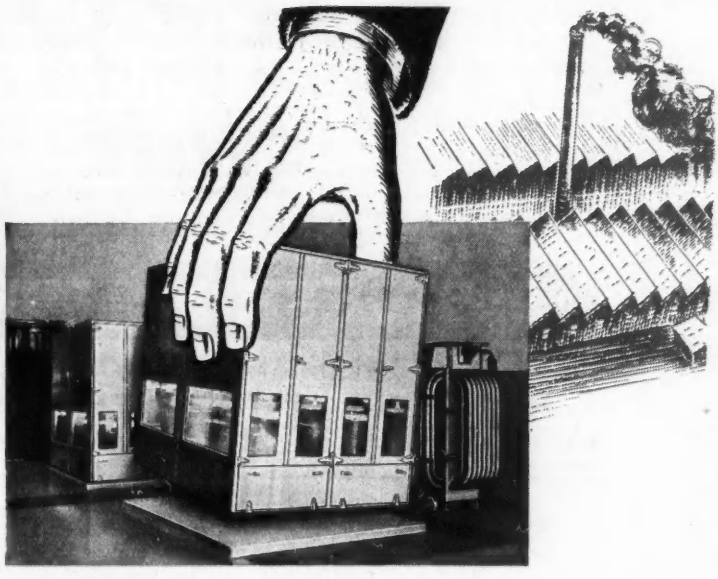

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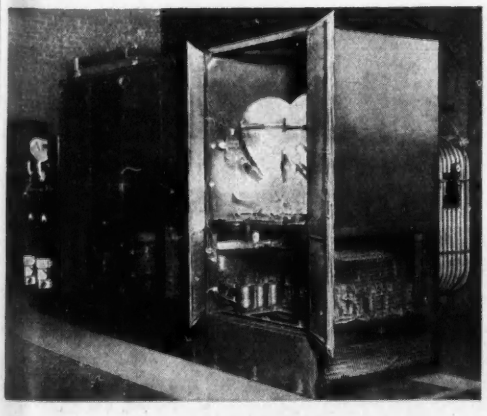

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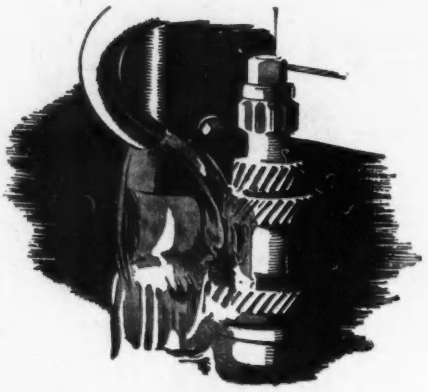

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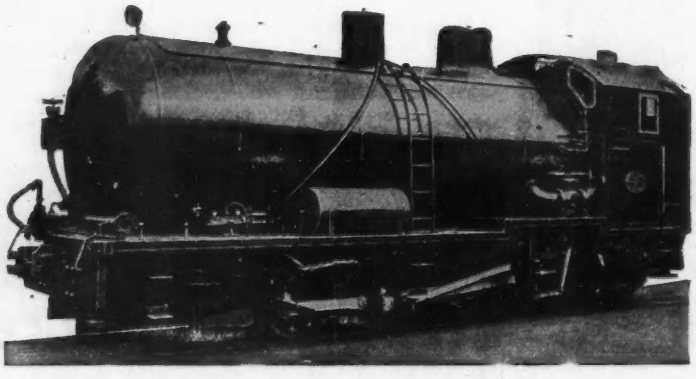

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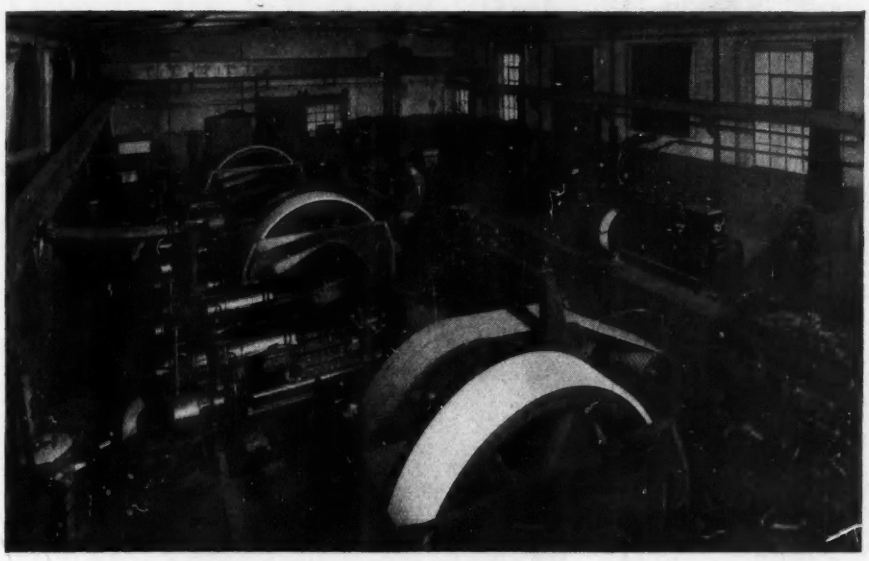

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The illustration shows the Crossley engines at the Hydraulic installation of the Manchester Ship Canal Company at Eastham Locks, Wirral.

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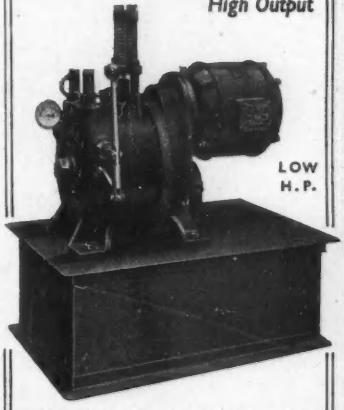

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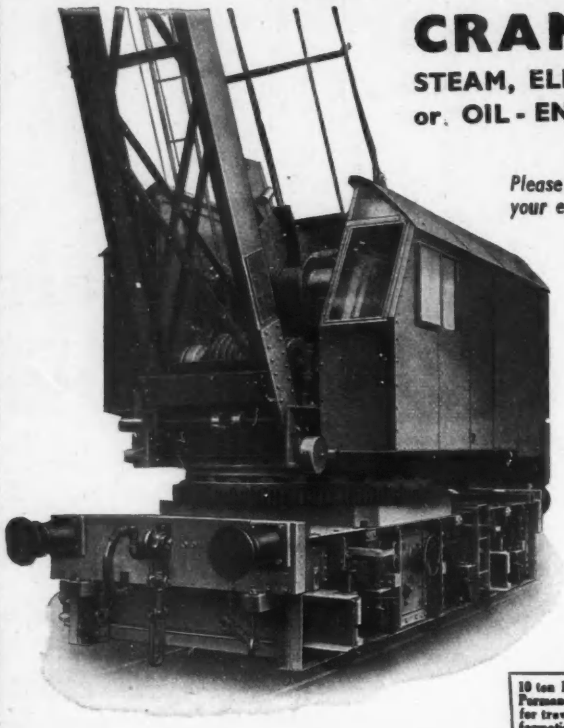

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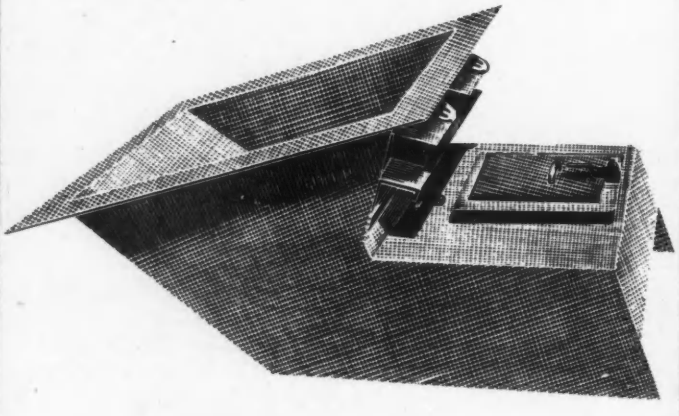

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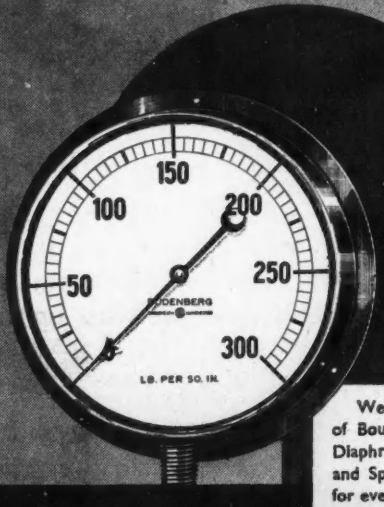

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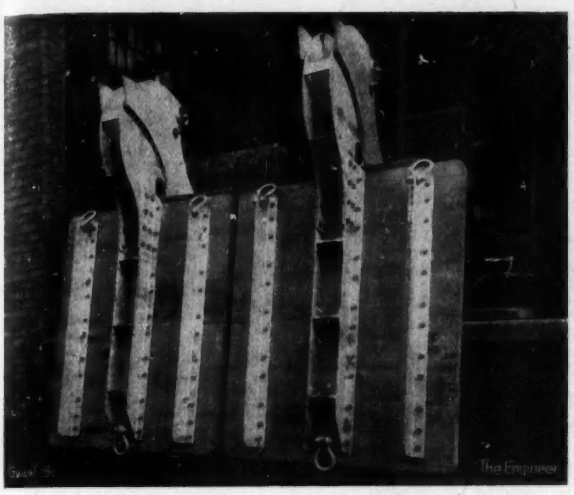

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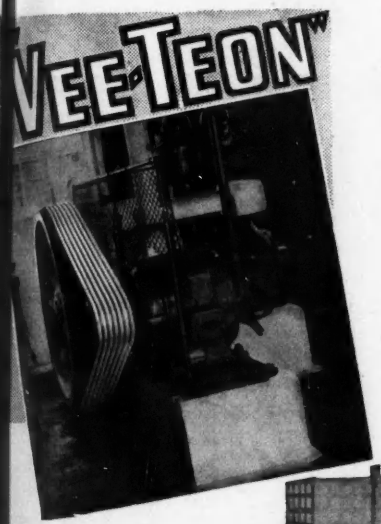

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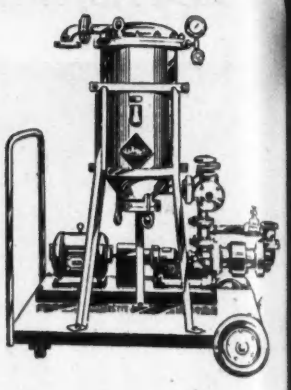

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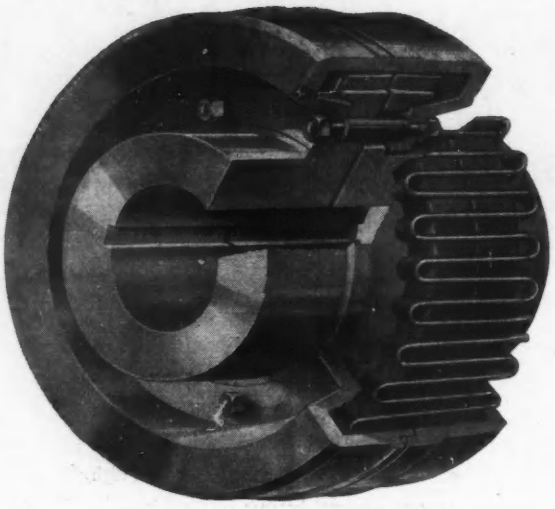

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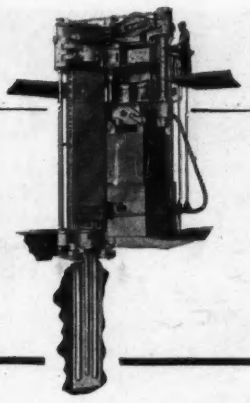

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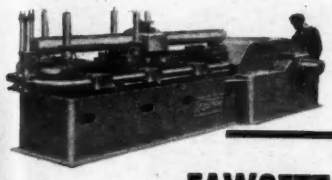

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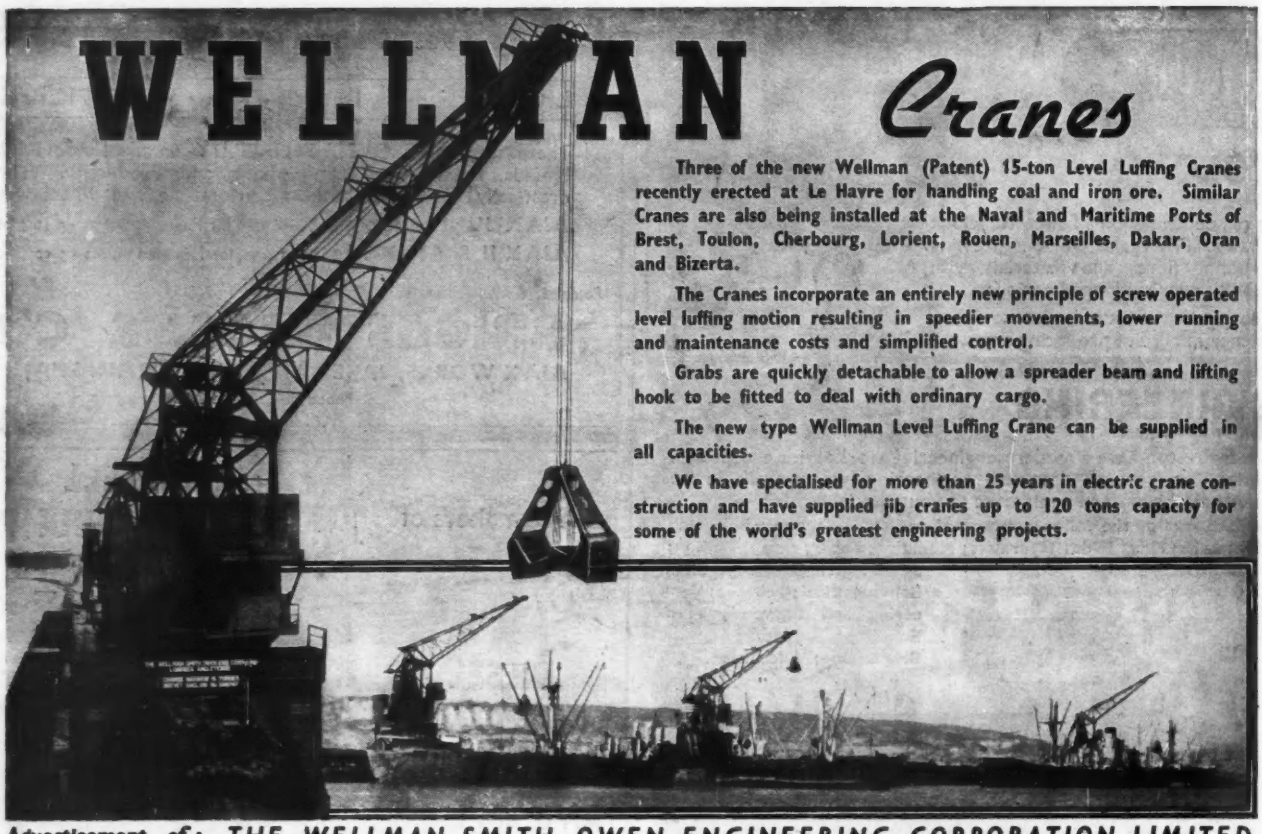

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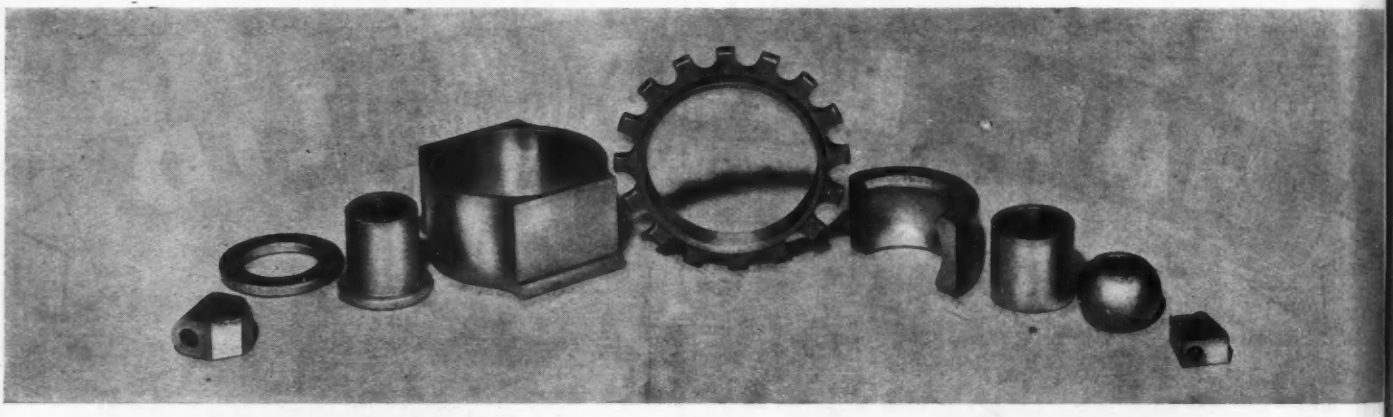

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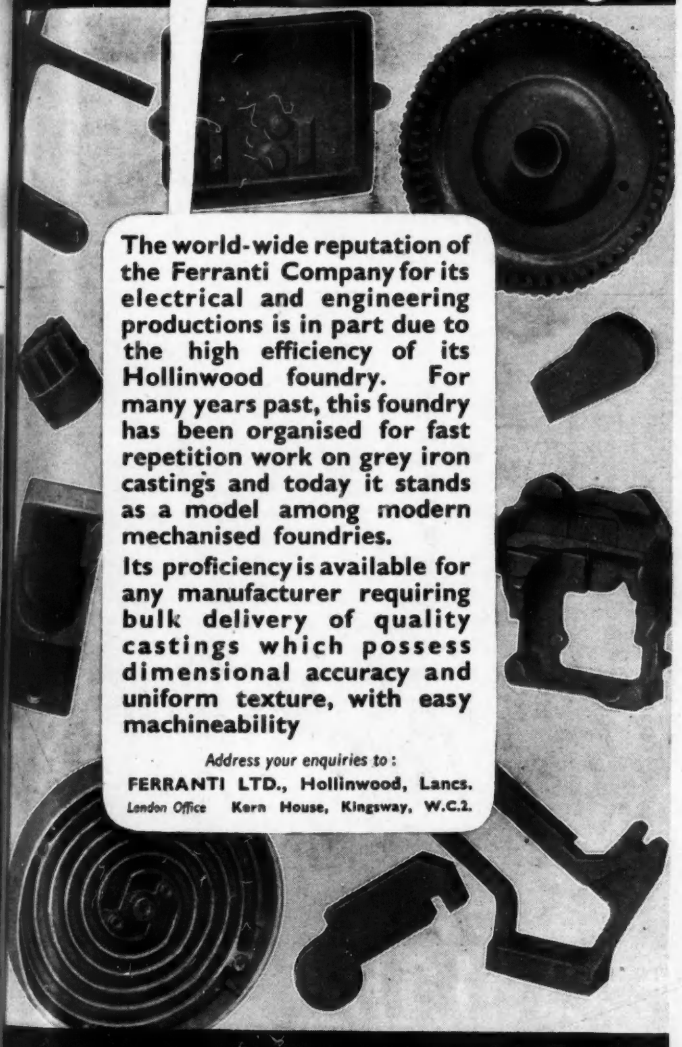

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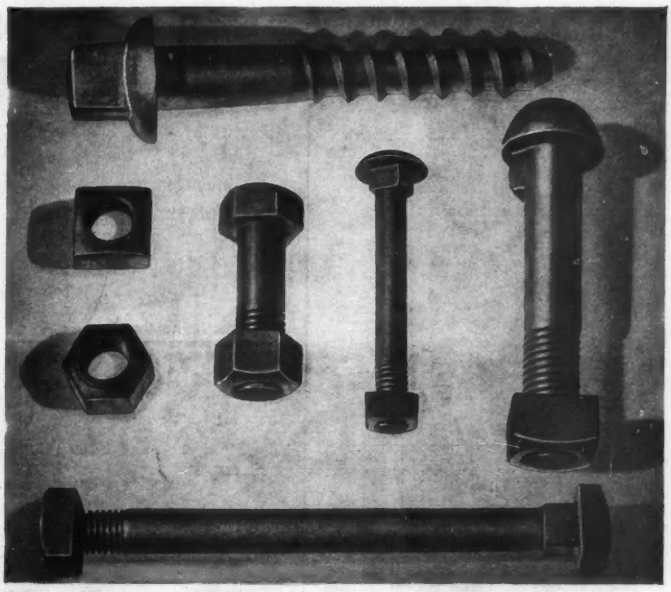

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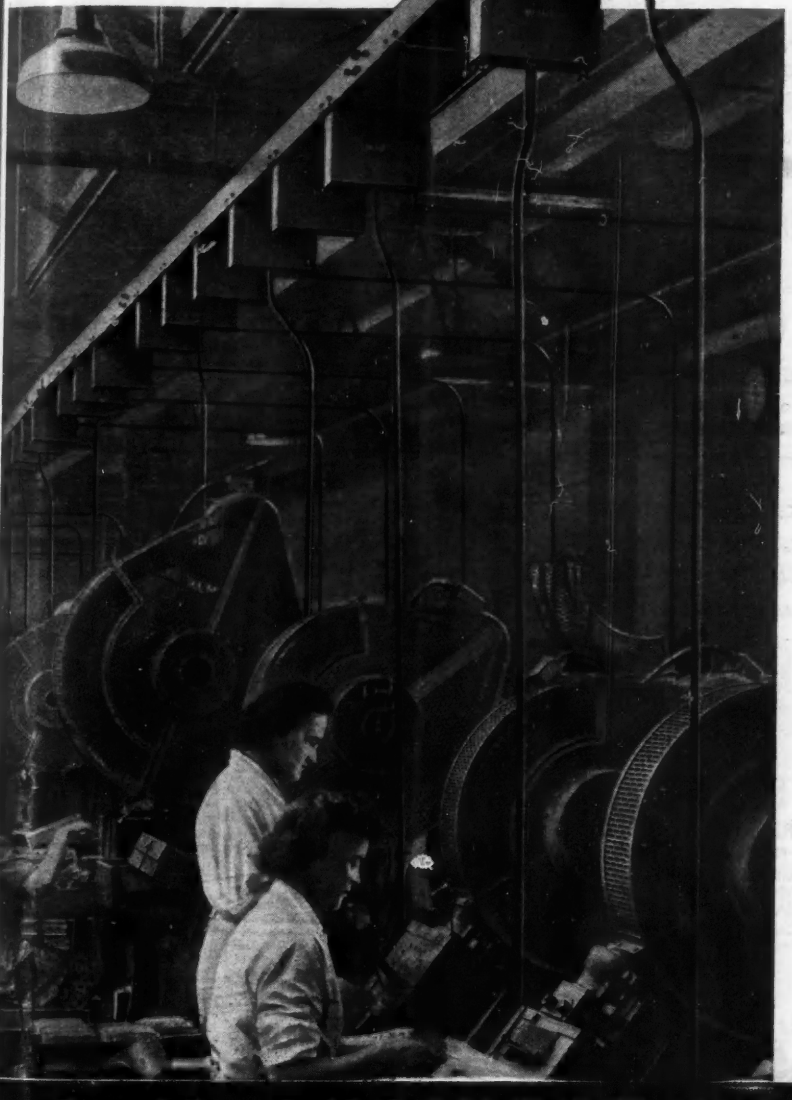

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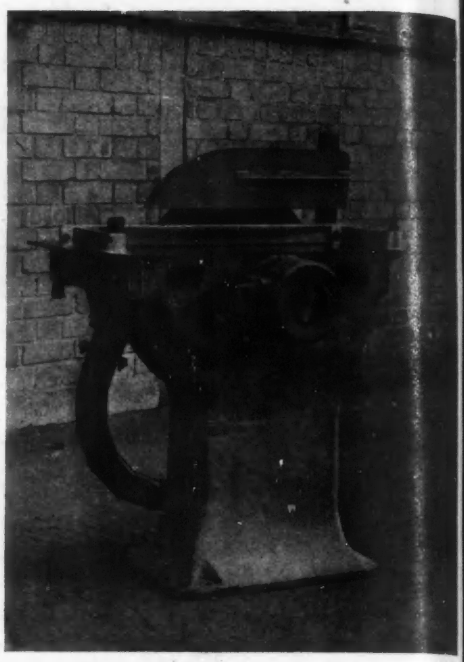

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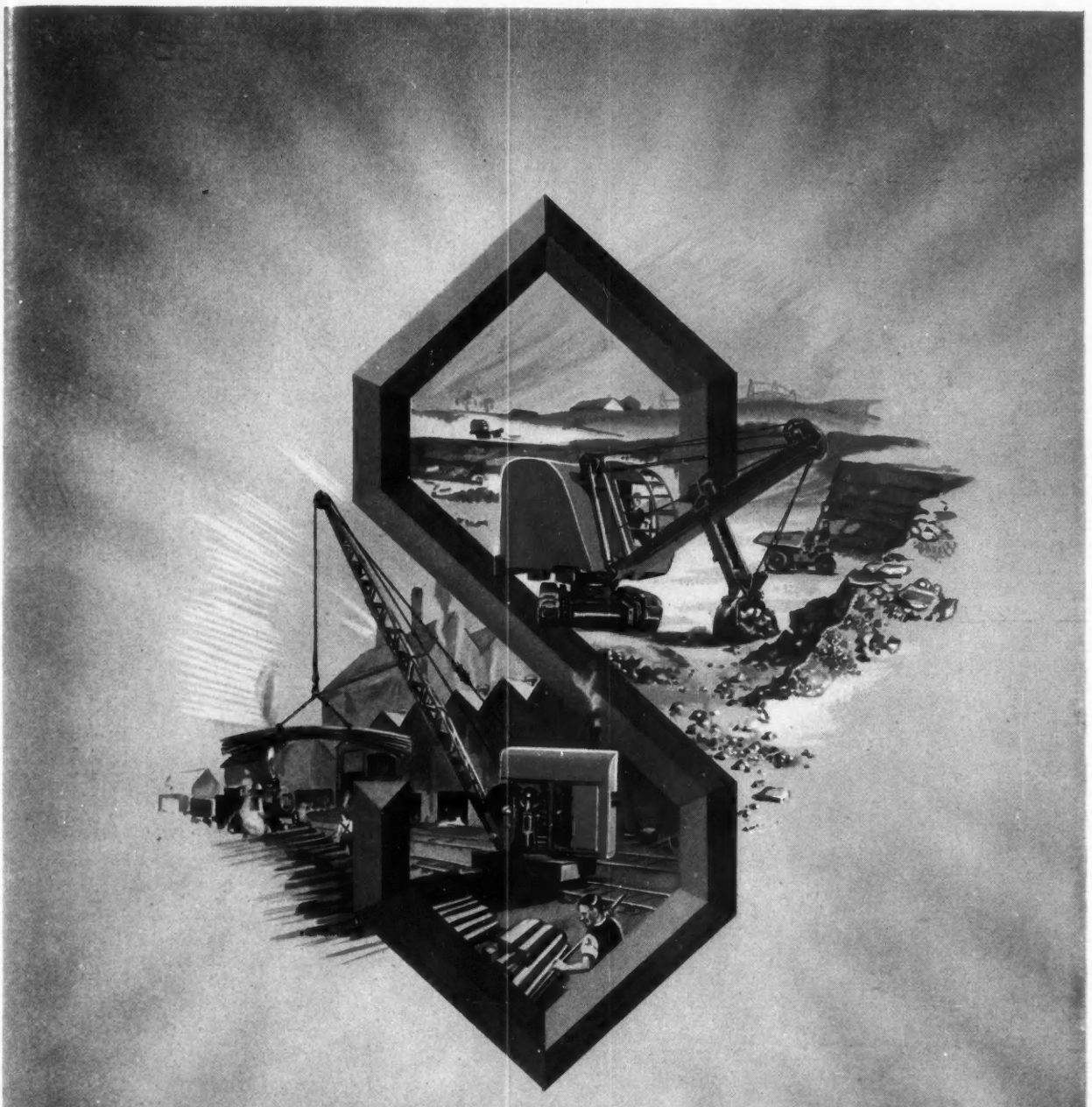

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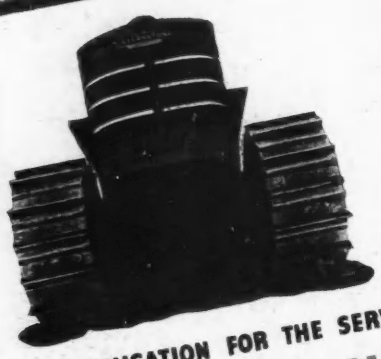

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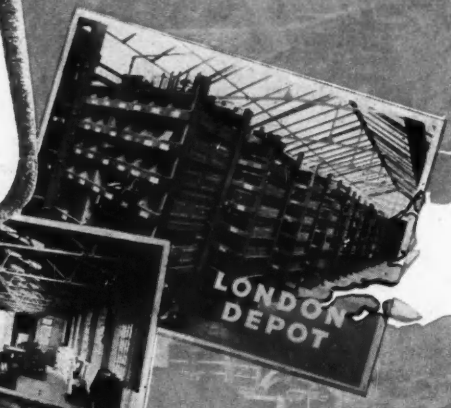

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